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NOTE ON THE GROWTH OF SOME INTRODUCED TREES AT THE CAPE.

Most people have heard how European fruit trees and vegetables have thriven when introduced into Australia, especially in the south-east temperate corner, which embraces Victoria and the greater part of New South Wales. A continental flora, rich in strong species and in a variety of species suited to every shade of environment, would naturally make terrible inroads into a restricted island flora. The little temperate region of Australia is cut off from the vast temperate region encircling the northern hemisphere by the semi-tropical region of central and northern Australia and the equatorial seas and islands further north. Africa presents the spectacle of the world's great tropical continent with a climatically temperate fringe of highlands clinging to its southern extremity. The temperate zone of Africa is still smaller than that of Australia.

In this temperate fringe of Africa there are now only small forest tracts, comprising altogether something under 200 square miles in area. There has been a considerable destruction of forests since the advent of the white man to South Africa (about 200 years ago); and there are fossil indications of pre-historic forests; but it is unlikely that the temperate forest region of South Africa was ever comparable, in point of size, to that of Australia. While, therefore, the temperate forest region of Australia has evolved the noble genus of Eucalypts, the smaller forest region of South Africa has evolved no trees sufficiently remarkable to be heard of outside their own habitat. Sneezewood (*Pteroxylon utile*) is a timber, which in point of durability, ranks with teak, yarrah and greenheart; and if there were only enough of stink-wood (*Oreodaphne bullata*)* it would keep most imported timber out of the market. But stink-wood

* It is remarkable that in the widely separated forest floras of Cape Colony and Madeira the most valuable forest tree in both countries is a species of *Oreodaphne*.

is scarce and sneeze-wood small; and yellow-wood the most abundant and best growing tree, has a poor reputation as timber. The temperate forest flora of Africa in fact is a small weak island flora, and when we consider how the strong continental floras of the northern hemisphere are making good their footing in the strong island flora of Australia, we may now conclude, that in South Africa there is every hope of very materially improving the forest resources of the country by a judicious introduction of exotic timbers.

In Cape Colony a limited but successful attempt has been made to plant exotic trees on a large scale. That exotics have not been largely planted is scarcely to be wondered at, when it is considered that it is only quite recently that attention has been turned to preserving the fine natural forests of the country. As in other colonies, there are botanical gardens in large towns, very useful disseminators of seeds and plants and young trees. But the young trees sold are usually fruit trees. The pine and oak plantations near Cape Town are the only example of the planting of exotic timber trees on any large scale. I have used the word "plantations," but "woods" is the proper term to employ. The Cape Town pine woods are composed of two pines, *Pinus Pinaster* (the *pin maritime* of the French), and *Pinus pinea* (the stone pine of Italy). These pine woods are one of the most remarkable features in the charming strip of fertile country stretching along the south-east or temperate side of the Table Mountain range. Like true pines they reproduce themselves with the greatest facility. In favourable positions the young pines come up like grass under the old trees. Even on the northern, or dry warm, side of Table Mountain, plantation owners are in the habit of clean-cutting the pine plantations, and leaving reproduction to take care of itself. When it fails, as it must sometimes with this treatment, artificial sowings yield an abundant crop of seedlings. Unfortunately fire sometimes destroys large areas of these pine plantations. Outside the wooded gorges of Table Mountain, the only indigenous tree is *Leucodendron argenteum*, commonly called the silver-tree, from the white silvery tomentum, which covers the leaves like the nap of a silk hat. The habitat of this peculiar tree is confined to the more cool temperate climate of the Cape peninsula. At pretty sylvan Wynberg, and elsewhere on the slopes of Table Mountain, there are natural woods of the silver-tree—sparse open woods with foliage glittering white in the mild clear light of this latitude. Into these unique woods have crept the dark European pines, and the mingled tints are picturesque, offering food for reflection. How far will the strong obtrusive but useful northern species eventually oust the pretty useless southerner? Black and white exist here side by side, as elsewhere in Cape Colony, and, just at present, there is room for both. *Pinus Pinaster* and *Pinus pinea* are the only two pines which

have become naturalized in Cape Colony. The Scotch fir, mentioned in books of travels as growing abundantly at Cape Town, is *Pinus pinea*, Scotch fir or pine being the colonial name for that species. Mr. Lister, the Forest Officer of the Cape division, who has had a long experience with *Pinus pinea* and *Pinus Pinaster*, estimates the rate of growth of the second at about half that of the blue-gum, and of the first about half that of the second. The blue-gum at the Cape does not appear to grow quite so fast as on the Nilgiris. Probably the acre-increment of a close plantation of *Pinus Pinaster* is about five tons (dry wood), and of *Pinus pinea* not more than two or three tons. The edible seed of *Pinus pinea* is not utilized in Cape Colony: its timber is superior to that of the faster growing *Pinus Pinaster*. Both pines show distinct annual rings, quite as distinct apparently as the rings in pine wood grown in Europe. European pitch-pine and deal are very largely imported: in fact, Norway deal is as common in Cape Colony as it is in England. The tropical white-ant is unknown in Cape Colony, so that a tough light wood such as deal is the most generally useful that could be grown. Some stumps of *Pinus pinea* on the northern slopes of Table Mountain gave an average of from five to eight rings per inch of radius: this was with trees 25 years old. In the more recently settled eastern portions of Cape Colony there are naturally not the large pine plantations which are so pleasing a feature in the Cape peninsula. But as far as can be judged from planting on a small scale, *Pinus Pinaster* seems to succeed as well in the east of the Colony as in the different climate of the west (I shall conclude this notice with some remarks on the climate of Cape Colony). Some interesting planting, mostly of *Pinus Pinaster*, has been done on the bleak hills which surround the eastern town of Grahamstown. Not only does *Pinus Pinaster* show a good growth there, wherever planted, but in one spot I observed some remarkable natural reproduction. In a gully was a cluster of planted *Pinaster* pines, showing as fine a growth as is usually met with near Cape Town. I measured one tree 6 feet in girth and 90 feet high, and not an old tree. For it is not much above half a century since the English came and planted their trees and houses on the bare hills now occupied by the smiling little town of Grahamstown. From these trees in the gully young trees, self sown, have spread up the grassy hill side. This was at an elevation of about 1,800 feet, and 40 or 50 miles from the southern coast. It shows that *Pinus Pinaster* can be used here for forest purposes, not only on the seaboard (as in France), but at moderate elevations inland. The Cape Forest Department has now some *Pinus Pinasters* planted still further inland, and at an elevation of 4,000 feet. I do not think the climate will be too severe even at this elevation: frosts there are only such as occur during night, and snow never lies for more than two or three days: the

climate is damper than at some parts of the coast, and I anticipate that both *Pinus Pinaster* and *Pinus pinea*, especially the latter, will succeed there, even better than on the coast.

Pinus pinea is a rather striking feature in Italian scenery from Brindisi upwards. Too often the Italian mountains, bared of forest and cut to pieces by torrents, yield now nothing but the scantiest grazing, and on the rare occasions when the peasant enjoys a fire he draws this luxury from the loppings of the *Pinus pinea* trees in his fields. *Pinus pinea* is naturally one of the most flat topped of pines when old. In Italy this peculiarity is exaggerated by lopping, giving those umbrella-like trees which are sometimes as characteristic of Italian pictures as are palms in paintings of tropical scenery.

The pine trees near Cape Town, with their symmetrical trunks, their lofty dense covert, and their abundant natural reproduction, recall the fir forests on the sandy plains of Alsace. They are certainly equal to the spruce and silver fir, which I had an opportunity of seeing recently in the Vosges.

Almost as successful an introduction as these two pines is the oak (*Quercus pedunculata*). The Dutch brought the tree with them from Holland 200 years ago, and it was the early Dutch settlers in the south-west who planted those groves which are now such beautiful sights in many of the old western towns of the Colony. Various writers, from Anthony Trollope upwards, describing these picturesque Dutch villages, expatiate on the beauties of the old oak avenues—the cool substantially built houses, lying embosomed in oak foliage, and backed by stretches of rich vineyard. This picture is a contrast to the oven-like modern tenement, crowned with its hideous iron roof! In the young English towns of the eastern part of the Colony, the oak has been planted sparingly along with other trees, and there as a foliage tree it seems to have out-distanced all others, though of course Eucalypts show a more rapid growth. The striking feature of South African streets is their extraordinary width, the reason assigned for this being the difficulty of manœuvring the huge waggons of the country. As a consequence, the impression left is somewhat that of a dreary waste of dusty macadam with dwarf houses in the distance. What more calculated to relieve this, and the glare of a nine months' summer, than a double row of oak trees! In the Grahamstown botanical gardens there is a fine show oak tree, its too spreading limbs held together by bands of iron against the strong South African wind. There is a fine avenue of old oaks near the botanical gardens and the new Houses of Parliament at Cape Town. The restoration of this avenue was made over to the Forest Department, and the treatment applied is described at length in the last Annual Forest Report of the Colony.

Fresh from India, and after ten years spent in its torrid fire-swept forests, I must confess that few sights have afforded me

greater pleasure than the bursting into leaf of the oaks in Cape Town, at the end of the brief Cape winter. It was pleasant to renew acquaintance with our hoary old friend "*le chêne pédonculé, messieurs*"! In Italy, Switzerland, and France, I had found the oak leafless; in June, in Cape Town, its last leaves were rustling to the ground. Two months afterwards, towards the end of August, the trees were assuming the glory of their spring foliage.

I cannot remember whether the bursting into leaf of the oak in this mild Cape climate is more sudden and vivid than the same phenomenon in Europe. Certainly it was here very beautiful! And it recalled memories of the old Nancy days and of friends now scattered far and wide. Poor Bagneris has gone to that last rest whither many a tall oak had preceded him; and many of us, buried in the wearisome tropics, have almost forgotten the oak and all he told us about it. I have seen the same old oak fighting a losing battle in Southern India.

The oak at Ootacamund, at an elevation of 7,500 feet, makes twice a year faint-hearted attempts to come into leaf after the south-west monsoon and at the end of the cold weather. Elsewhere in Southern India, 4,500 feet is the lowest elevation at which I have noticed the common English oak planted and growing. It is never leafless there, is stunted, and of poor growth, but still bears fertile acorns. In the eastern portion of Cape Colony, where the climate begins on the coast to show semi-tropical features, the oaks do not lose all their foliage regularly, but the yield of acorns is abundant and regular.

The species of oak which has been planted in Cape Colony for 200 years appears to be exclusively *Quercus pedunculata*. Count de Vasselot in his tours has found only this species, though he informed me that he had searched carefully for *Quercus sessiliflora*. Of the two common European oaks, *Quercus sessiliflora* has a rather more southerly habitat than *Quercus pedunculata*.

It is surprising that this oak should have become so completely naturalized in a climate undoubtedly warmer than its European habitat. In the damper, more European-like climate of the Cape Peninsula, the naturalized Cape oak reproduces itself with facility by self-sown seedlings. All over the Colony the oak bears acorns abundantly and more regularly than in Europe (within my remembrance). The common method of planting oak trees in avenues or near houses, is to go into an oak wood, and dig up a sapling 6 or 8 feet high, and with about as much root as would go into a large kettle. That trees should survive such a treatment is one proof of thorough and hardy acclimatization. I believe that the wood of the Cape oak is not inferior to the wood of the European oak, that the oak in Cape Colony grows faster than in Europe, and that the decay to which the oak in Europe is liable sets in earlier here. No

attempt has been made at coppicing or barking the oak or treating it as Foresters treat the oak in Europe. In the eastern mountainous forests of Cape Colony, it is probable that the oak would be thoroughly at home. Acorns are now being sown in glades and burnt areas of forest with the view of testing this. How far this oak may be useful for afforesting purposes, or how far it may spread into the indigenous forest, will be an interesting subject of future observation.

After seeing the fine specimens of the Turkey oak (*Quercus Cerris*) at Kew, the reflection is natural that if *Quercus pedunculata* grows well in Cape Colony, *Quercus Cerris* ought to grow better. And *Quercus Cerris* is a finer tree, yielding better timber than *Quercus pedunculata*. An application has been made to Kew for acorns of *Quercus Cerris*, in order to test its growth in different parts of the Colony. There is an oak, said to be *Quercus Cerris*, and to be about 8 years old now, growing in the Government Gardens at Cape Town. It is stated to have not yet produced good acorns. We should be thankful to any friend (and happy to exchange seeds with him) who would send us some Himalayan acorns, or indeed any Himalayan seeds, notably Deodar.* And here it may be remarked, that the climate of the eastern forest country of Cape Colony, resembles the temperate climates of the Himalayas, in its comparatively dry winters with occasional falls of snow, its rainy summers, its latitude, and its mean temperature. It differs in being subject to droughts at intervals of from 5 to 10 years, and to brief hot winds from the interior, which send the thermometer above 100° for some hours. These hot winds may blow at any time of the year, though they are mitigated in winter. In winter they do not range much above 80° Fah. In summer they reach 110° and occasionally 115°. During the night they are always stopped, especially near the sea, by a cool current from the Southern Ocean, and differ in this respect from the hot winds of Australia, which blow at a temperature of about 120° for two or three days together. The best of the eastern forests of Cape Colony are between elevations of 3,000 and 4,500 feet, which in mean temperature probably corresponds with an elevation of between 6,000 feet and 7,000 feet in the Himalayas.

Amongst the introduced timber trees of Cape Colony, after the European pines and oak, it will be proper to speak of the blue-gum of Australia (*Eucalyptus globulus*). The blue-gum is more widely planted in South Africa than any other tree, but it rarely shows self-sown seedlings, and consequently has not the forestal value of the oak and the pines. I shall not easily forget my introduction to the blue-gum, in its own hemisphere and latitude. It was my first morning on shore near Cape Town. People with their English habits were in bed

* We will endeavour to meet KAD HANDI'S wishes as soon as possible.—[ED.]

or at breakfast, and I had the fresh morning air to myself. There was a lightness and a freshness about this air, wonderfully recalling the Nilgiris, and this illusion was complete when I passed out of the perfumed pine woods to where some giant blue-gums stretched their limbs across the road, and filled the air with their strong wholesome scent. All along the coast of South Africa, from above Cape Town to Natal, the blue-gum grows with facility and rapidity—nearly the same powerful assimilator of carbon that it is on the Nilgiris. Ten tons has been mentioned as the acre-increment in Natal. Approaching the colder western coast this figure probably diminishes, but there are no plantations sufficiently large and regular on the coast to afford any reliable figures of growth. In the drier climate of the interior, the blue-gum succeeds best when there is subsoil moisture. It is extensively planted round farms everywhere, and is said to have modified the mild malarial fever which is prevalent in some portions of the Transvaal, an elevated plateau (about 4,000 feet elevation) which extends northwards into the tropics.

On the same plateau, at the large English town of Kimberley (the diamond fields), where a bad form of malarial fever is prevalent in summer, and where firewood sells at fancy prices,* Eucalypts have been planted just sufficiently to show that they will grow well there. There is now a plentiful supply of water at Kimberley from the Orange river, and altogether the best prospects of successful Eucalypt planting. The only portion of Cape Colony where the blue-gum appears not to succeed is on the last range of high mountains rising to the plateaux of the interior. On these mountains, especially if the aspect is southerly, the snows and frosts of winter are too severe for the blue-gum. In the semi-desert country to the North-West, where the rainfall ranges from 10 to 15 inches down to only a few scanty uncertain showers, Eucalypts can naturally not be grown without irrigation. The blue-gum and other Eucalypts have been most extensively planted in the neighbourhood of Cape Town. In certain situations they suffer there from wind, and the wood, as firewood, has a bad reputation for being twisted in the grain and difficult to split. Grown in close plantations these objections would probably disappear.

Speaking generally, the blue-gum appears to grow less rapidly in Cape Colony than on the Nilgiris, and there are other Eucalypts which rival, or even surpass it, in rapidity and robustness of growth. In appearance, the average blue-gum on the southern sea-board of Africa is about equal to those I saw in Italy, both being somewhat inferior to the Nilgiri tree.

* At the present moment, owing partly to a small-pox scare, the price of firewood is mentioned in the papers as being £50 a load at Kimberley. Imagine the value of a few acres of blue-gum with an acre-increment of ten tons and these prices.

With regard to the natural reproduction of the blue-gum, coppice shoots are not so plentiful nor so strong, as I remember them a year ago, on the Nilgiris ; but on the other hand, self-sown seedlings occur in certain situations in Cape Colony, while on the Nilgiris it is a notable fact that they are practically non-existent. Probably both the lessened power of coppicing, and the occurrence to some extent of self-sown seedlings, is due to the fact that the Cape climate is drier* than that of the Nilgiris: the Cape climate is warmer as regards air temperature than the Nilgiris, but as regards the sun quite extra-tropical, being in latitude 34° as against the 11° of the Nilgiris. The mean temperature of Cape Town is 61·25, and the rainfall 24 inches. On the cool side of the Table Mountain range, where the pines, oaks and blue-gums attain such fine dimensions, the rainfall is greater and the temperature slightly less. On the Nilgiris, where the blue-gums grow best, the mean temperature is about 56°, and the rainfall 45 inches. It is remarkable, that the best show of self-sown blue-gums in Cape Colony, is believed to be at a farm some distance from the south-west coast, where the rainfall is less than in Cape Town. Here, in this one locality, the young blue-gums are described as coming up like grass : the situation is dry and open, and the soil somewhat stony. Near Cape Town, self-sown blue-gums are observable, but they are not common. All over Cape Colony the blue-gum produces fertile seed, and no other is used in nurseries ; while on the Nilgiris, it is necessary to use Australian seed on account of the bad quality of indigenous seed.

Of other Eucalypts only one I believe has been at all extensively planted. This was at first believed to be *Eucalyptus Mahagoni*, but was subsequently identified as *Eucalyptus robusta*. In Southern India I found it to succeed at 2,000 feet lower elevation than *Eucalyptus globulus*, and in Cape Colony it appears to stand drought better than *Eucalyptus globulus*. Mr. Lister is very sanguine of its successful and easy planting. I have rarely witnessed a more rapid and vigorous growth than that shown by this tree in the town avenues and in the Government plantation at Worcester. It is now being tried in the east of the Colony. Its compact form, and (for a gum tree) dense foliage, render it fit for avenue planting.

Of other Eucalypts, a great variety has been planted, by twos and threes, in different parts of the Colony. Very many of these I recognize as having been more or less successfully planted in Mysore. The valuable yarrah has been identified

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* We should add "and warmer." The greater dryness has for result the production of a smaller number of buds, while, on the other hand, the higher mean temperature, and the presumably brighter sun force a larger number of these buds to develop into leaf and wood, thus allowing a comparatively small number to remain dormant.—[Ed.].

by Mr. Lister, growing near Cape Town, and yielding good seed. The sweetly scented *Eucalyptus citriodora*, which succeeds as a garden tree in Mysore, grows well in Cape Colony, but was found to be sensitive to drought in the Botanic Gardens at Port Elizabeth on the southern coast.

KAD HANDI.

(To be continued).

GUINEA-GRASS AND LUCERNE.

IN dealing with the important question of fodder-reserves, it is profitable to notice the great success which has attended the cultivation in this country of guinea-grass (*Panicum jumentorum*) and lucerne (*Medicago sativa*). Lucerne is grown in small quantities in most places where Europeans are to be found, but guinea-grass is not so generally known. It was introduced into India apparently not much earlier than 1870, in which year it was cultivated at the Madras Experimental Farm. Directions for sowing it are contained in the Proceedings of the Agri-horticultural Society for 1871. The Agricultural Department, Punjab, has recently published a short collection of disconnected papers on guinea-grass and lucerne, but there seems to be no other such publication ; and it is probable that if any exists, it is to be found only in official libraries, and consequently inaccessible to the general public. Lucerne is alluded to in the Introduction to Duthie's *Grasses of North-Western India*, but it is not mentioned elsewhere in this book, and finds no place in Duthie and Fuller's *Field and Garden Crops*. Pogson in the *Manual of Agriculture for India* disposes of lucerne in half a page, and guinea-grass he mentions not at all. He gives high praise to buffalo-grass (*Euchlana* or *Reana luxurians*), but if it is to be cultivated as Pogson instructs, it is doubtful if any one will cultivate it at all. It requires too a very rich soil and heavy irrigation, and cannot be grown on a large scale except at great expense.

In the plains of India it is impossible to cultivate clover and the pasture-grasses of Europe. The heat of summer destroys them at the time when fodder is wanted most. Dúb grass is almost everywhere available, but it is a poor food in the hot weather, and does not repay cultivation. If therefore good fodder is required, resort must be had to grasses which will flourish even in the hot season either with or without irrigation. Lucerne and guinea-grass seem to answer these requirements. Lucerne will grow anywhere in the plains, and if irrigated will keep green through the hottest weather. Guinea-grass will grow on fairly good soil without irrigation even in the hot weather, provided that care be taken of it when young. It

dries up at the first approach of frost or cold weather to shoot up again in the spring; while lucerne grows all the year round except in September and October.

Guinea-grass may be cultivated either from seed or by means of cuttings from the roots of old plants. The beginning of the rains is the best time for sowing, but with care guinea-grass may be raised at any season. The seed should be sown thickly in beds well pulverised and manured. If the seedlings are to be transplanted, the seed may be sown broadcast; if no transplanting is to be done, the seed should be sown in drills 2 inches deep and 2 feet apart. Great care must be taken to keep the young plants free from weeds, and for this reason sowing in drills is preferable to broadcast sowing. Seedlings may be transplanted when 4 or 5 inches high. The ground in which they are to be placed should be well broken up and harrowed; and the young plants should be set out in rows 2 or 3 feet apart. If there is no rain the seedlings should be watered daily. When the rains set in they need no further care except to be kept free from weeds. Weeding should be continued till the seedlings are 18 inches high, when they may safely be left to themselves. From seed sown early in the rains green fodder may be cut in August if the growth has been at all successful; and hay may be made towards the end of September when the grass is neither too green nor too dry. Guinea-grass when in full growth requires little care, but it should be manured occasionally in the cold weather, and will be all the better for irrigation in May and June.

If guinea-grass is to be raised from rootlets these should be pulled off from old and strong roots, and planted at short intervals in ground prepared as for seed. The outturn of guinea-grass per acre is very heavy, and may be anything up to 1,000 maunds. The Municipal garden at Coimbatore in 1876 produced an average crop of 960 maunds per acre on a field of five acres. In 1878 at the Cawnpore Experimental Farm the outturn was at the rate of 360 maunds per acre. In 1881 at the Saharanpur Botanical Gardens the yield was 600 maunds per acre. The average outturn of green *juár* or *chari*, which is the principal fodder crop of Northern India, is 300 maunds per acre *(Field and Garden Crops, Vol. I.)* These figures are worth consideration. Independently of the actual yield of guinea-grass, it is far superior to *juár* in hardiness and power of resisting the effects of drought; and it is a perennial, while *juár* is an annual, plant. Furthermore being a perennial grass, its roots grow strong and large, and make their way deep into the soil, where moisture is found which no annual plant could reach.

Lucerne is cultivated with very little difficulty. It should be sown broadcast on ground well broken up and manured. According to Pogson and other authorities the spring is the best time for sowing, and lime the best manure. The outturn of

lucerne varies according to circumstances, and should not be less than that of guinea-grass. In 1883, four bighas under lucerne at Dera Ghazi Khan produced 930 maunds of green fodder in six months (January to June).

J. S. C. D.

GEOLOGICAL MAP OF THE MUNICIPALITY OF MUSSOORIE WITH THE LANDOUR CANTONMENT AND RĀJPUR, N.-W. PROVINCES.

THIS Map shows the different kinds of rocks which are found within the limits of the Municipality of Mussoorie. Mussoorie hill station occupies a large portion of the Mussoorie hill range, which extends from the River Jumna eastwards, and rises between the elevated valley of Dehra Dún and the valley of the Aglar river which flows into the river Jumna. The range begins with the prominent Badráj mountain (7,318 feet above sea level). Minor peaks are—

Banóg, ...	7,432	feet.
Cloud-end, ...	7,062	„
Háthipaon, ...	7,088	„
Abbey Hill, ...	7,092	„
Blucher's Hill, ...	7,187	„
Vincent Hill, ...	7,006	„
Camel's Back, ...	7,029	„
Castle Hill, ...	6.909	„
Landour Station, ...	7,533	„
Masráná, ...	7,699	„

Furthest east beyond the boundary Tóp Tíba 8,569 feet.

Rájpur is situated at the foot of the range, and the lowest point is only about 3,000 feet above the sea. In this low situation we find the youngest rocks, the tertiary sandstones of the Dehra Dún. They are not much exposed owing to the presence of more recent débris and alluvium. Near a ruined house called Constantia, there are large blocks of a white sandstone, which I take for tertiary.

The main range is made up from a succession of sedimentary strata, aggregating to a thickness of about 6,000 feet. In addition there are numerous outcrops of trap. The age of the sedimentary strata is not fixed because fossils are absent. It is, however, very probable that the limestone series is identical with that of the Król near Simla, which is thought to be contemporaneous with the Trias. All the strata of the main ridge may, therefore, be taken as earlier secondary.

The following is a list of the strata, with their estimated thickness arranged in descending order. The tertiaries already mentioned as belonging to the valley of the Dún are placed at the

beginning, and the list concludes with the eruptive trap rocks, which will be referred to hereafter :—

Tertiaries, ...	800 feet.
Jhabarkhet white quartzite, ...	300 „
Landour grey grits and shales,... ...	500 „
Khaki shales, ...	200 „
Chertbanks and carbonaceous shales, ...	100 „
Limestone beds, ...	1,200 „
Yellow shales included in the limestone beds, ...	200 „
Rájpur quartzites, ...	600 „
Blue and variegated shales, ...	600 „
Trap, ...	eruptive.
Total thickness of sedimentary strata, ...	4,000 „

The lowest rock consisting of dark blue shales, is well seen on the ascent of the road from Rájpur to Mussoorie. The toll house is built on this shale, and the dark blue outcrops are seen a good distance along the base of the range. On the road from Rájpur to Sahansra Dhára, a point three miles east of Rájpur, these same shales are seen to continue, and even to form small hills in front of the main range. The dark blue shales are succeeded by purple and green shales, which show particularly well along Mackinnon's Brewery cart-road.

Next in ascending order follow grey shales and whitish quartzites. In the region of the quartzites on Mackinnon's cart-road were found blocks of barite amongst the débris of the hill side. No barite was found *in situ*. After the quartzites and grey shales a few beds of varying composition and color with calcite veins and dolomitic concretions bring us to the great limestone formation. This limestone formation, excluding about 200 feet of enclosed yellow shales, has a thickness of about 1,200 feet. The yellow shales divide the formation into about equal parts. The lower part consists to the greatest extent of dark crumbling more or less porous rock. Much of this is pure dolomite, and one analysis showed, besides much hydrogen sulphide and bituminous matter, 0·1 per cent. of free carbon. This free carbon is left as a soot black powder when the rock is dissolved in acid, and it is sufficient in quantity to account for the dark color of the rock. This rock occurs along the Rájpur-Mussoorie road repeatedly, and must on no account be mistaken with the lower blue shales and with other black shales which will be mentioned hereafter. Some crumbling rock is mixed with pure white calcite so as to produce a speckled appearance. There are also about 20 feet of a pure white, very fine grained marble. This bank occurs near Jharipáni, and a similar specimen from Cloud-end has been analysed (Analysis No. 7).

In close proximity to this bank of pure marble there is near Jharipáni a vein of crystalline white dolomite about 10 feet

thick (Analysis No. 3). At one point there is even a layer of white sand intermixed with the limestone. The yellow shale is well seen near Fair-lawn on the Rájpur-Mussoorie road, and again near Barlowganj, also near Whymper's Brewery. The upper portion of the great limestone deposit contains more generally massive grey or dark blue limestone and grey dolomite. The very last layers consist of a more argillaceous dolomite. Some of the massive magnesian limestone has a peculiar structure and markings of rounded forms and twisted and curled veins. Such rock occurs between Barlowganj and Mussoorie. The massive dolomite forms many of the prominent cliffs and hill tops of Mussoorie. The prevalence of magnesia is shown by the analysis to which I will have to refer hereafter again. Gypsum of white color and distinctly crystalline occurs throughout the lower portion of the limestone formation. I could enumerate almost a dozen places where gypsum was found. The most important outcrops occur, however, in the valley of Sahansra Dhára in the limestone. The snow-white gypsum occurs in layers, which may aggregate to 20 feet thickness near Selkót, north of Sahansra Dhára.

At Sahansra Dhára blocks of gypsum are washed down by a torrent from the southern aclivity. Another mineral is magnesite, which was discovered by Captain F. Pogson in the limestones near the Happy Valley. I give the analysis (No. 4). Its occurrence is a further proof of the prevalence of magnesia. Calcareous incrustation is of course to be expected amongst such vast outcrops of limestone. Beautiful accumulations of calcareous tuffa are seen at Sahansra Dhára, at the Mossy Falls, Bhatta Falls, Kempti Falls, and other waterfalls which are often visited from Mussoorie. At Sahansra Dhára the springs and rivulets of water charged with calcium carbonate yield beautiful incrustations on leaves and woods and other objects. Calcareous tuffa is often used for building purposes, retaining walls, &c.

The tunnel which was made by the Sappers and Miners a few years ago, for the conveyance of fresh water in pipes, is pierced through the upper solid limestone beds on the northern spur of Castle hill, and is 500 feet long.

Above the limestone follow the chertbanks and carbonaceous shales. The chertbanks are black chert in layers of about 2 or 3, sometimes up to 6 inches thickness. Above them comes black highly carbonaceous shale containing much pyrite. At Castle hill between Mussoorie and Landour, in the so-called ash pit, these layers show very prominently with remarkable contortion. I found in the shales there pyrites in a piece 2 feet long and 2 inches thick.

Many other outcrops of these cherts and black shales occur, for instance near the Club and south of Landour bazar, also near Midlands, and on the slope of Pari Tíba, and far to the east near

Masrána. The relative position of the chertbanks can be made out so as to leave no doubt. They overlie the limestone series, and are accompanied by the black carbonaceous shales.

Next the dark cherts and carbonaceous shales come shales and grits and quartzites, which are particularly well known as forming the high ridge upon which the Landour Cantonment is built. I made three separate divisions, which are shown on the map. The lowest, that of the khaki or earth-colored shales, is also well seen on Castle hill. In the grey shales and grits quartz is predominating, but there are also banks and nodules of impure dolomite. Some of the dolomite is dark red, and contains so much iron, silica, &c., that it melts like slag to a black pearl before the blow pipe. (Specimen from near Haycroft on General Parrott's Estate).

The white quartzite is shown on the map with a separate color. It is of considerable thickness, very striking and often as white as marble. This is the uppermost stratum of the range.

Pari Tíba, or Fairy hill, shows a very regular succession of the strata from the limestone to the dark hard shales, which form the top, and which are identical with the Landour grits and dark shales. Midlands, a lower hill between Pari Tíba, Landour and Mussoorie, is crowned by the khaki shales.

Regular as the superposition of these beds is, they are anything but level in position. The limestone forms a great synclinal wave. From the great outcrop between Cloud-end and Castle hill it bends down below the Landour hill, cropping out deep down at Sahansra Dhára on the south, and in the Aglar valley on the north. Then it appears again at the top of the ridge near Masrána and Jalki rising to Tóp Tíba. The lower strata visible near Rájpur come up to the top of the ridge at Badráj mountain, where the quartzites of Rájpur road are evidently repeated, though forced up to so much greater height.

At the southern foot of the range the dark blue shales and the Rájpur quartzites dip northwards, and on mount Badráj north-eastwards.

The limestone beds between Badráj and Landour have generally a north-east dip, but there are great many irregularities and local contortions. The chertbanks and carbonaceous shales are of comparatively small thickness, and the contortions and irregularities of position are, therefore, all the stronger.

Near the Club and round Castle hill they are, in spite of the contortions, generally level, but on the south side of the Landour bazar they slope down with the hill side. At the junction between the limestone and the khaki shales on the Tehri road, west Landour, the chertbanks extend far down the southern hill side standing on edge. Round the western base of Midlands, the chertbanks crop out comparatively level, and the same round a portion of Pari Tíba hill.

The Landour grey grits and shales strike at Landour generally

parallel to the ridge, which extends from north-west to south-east, and their fall is towards the north-east. Then a synclinal is formed, and on the other side of the valley, on the Moru hill and Jhabarkhet, the strata dip towards the south-west. The white quartzites agree in their dip generally with the rocks on which they rest.

The trap rocks crop out in the limestone. One outcrop is on the Rájpur-Mussoorie road at Barlowganj. The road cuts through the trap for a distance of about 200 feet. The rock is much broken up, and it would not be possible to obtain many compact pieces of more than a cubic foot. The rock is of a greenish color and more or less speckled, owing to the different crystallised minerals, which are mostly in a decomposed state. Half a mile east from Barlowganj at the Mossy Falls several more outcrops occur. The largest outcrop is quarter mile north-west from Barlowganj at Whymper's Brewery. There we can go a distance of 1,000 feet along the Brewery road through trap. The next is at Snowdon, and two more near Cloud-end. Minor outcrops may be seen at St. George's School, on Mackinnon's cart-road between Bhatta village and Whymper's Brewery, and at the Park. Outside of the range of this map I found repeatedly outcrops of trap near Chamansari south-east from Pari Ṭíba on the way from Sahansra Dhára to Landour. The widespread occurrence of trap makes itself felt in the presence of fragments at Dehra in the gravel which is brought down by the torrents which rise in the Mussoorie range. This gravel is composed of the débris of all the Mussoorie rocks. The black chert banks are also well represented by fragments of the black chert. Limestone of all kinds is also there, but the bulk of the gravel is bluish shale.

The strata of the Mussoorie range include no good building stone. The limestones and dolomites are almost the only durable stones, and they are difficult to shape. The calcareous incrustations (tuffa) are sometimes used for building and for retaining walls. The Landour grits and shales yield some durable and well shaped flags.

Other shales are sometimes used for retaining walls, and after a few year's exposure they fall to pieces. The pure white marble which occurs in the limestone is all in fragments, the largest about a cubic foot. It is uncertain whether large compact pieces could be got from greater depths.

The most important mineral product is the common limestone of the range. Mussoorie proper is almost entirely built on limestone. The principal peaks—Abbey hill, Vincent hill, Camel's back, Banóg, and St. George's School, are all limestone. It has already been said that magnesia is very prevalent. The following shows the results of chemical analysis :—

1. Fine grey dolomite from the top of Camel's back.
2. Dark crumbling rock near Jharipáni.

3. White crystallised dolomite near Jharipáni (analysed by Messrs. Copeland and Blanchfield).
4. Magnesite from near the Happy Valley (Captain F. Pogson's discovery).
5. A mixture of 50 specimens from limestone and dolomite all over the Mussoorie range.
6. A mixture of 50 specimens of limestone and dolomite as they are used for lime burning in the torrent beds which flow down to Dehra.
7. Fine grained white marble from Cloud-end (Qualitative analysis).

	1.	2.	3.	4.	5.	6.	7.
Calcium carbonate, ...	58·9	50·4	48 8	13·5	56·7	72·4	100·0
Magnesium carbonate, ...	33·2	47·1	48·2	69·1	33·3	17·1	0·0
Residue of silica, alumina, &c., ...	4·7	0·5	0 3	13·2	6 1	9 6	trace.
Water, bituminous matter and loss,	3·2	2·0	2·7	4·2	3·9	0 9	0·0

These analyses show that there is not only strongly magnesian limestone forming one of the highest peaks, but the dark crumbling lower strata contain perfect dolomite. Further a collection of 50 specimens made promiscuously all over the station and hill range, resulted in a mixture which contained one-third of its weight of magnesium carbonate. This is ample proof that magnesium limestone preponderates in the outcrops. Somewhat purer limestone comes down with the boulders and gravels in the torrents which flow into the valley past Dehra. These limestone boulders and fragments are all picked up and burnt into lime. The analysis of 50 specimens gave 17·1 per cent. of magnesium carbonate. The limestone detritus which is washed into the valley, contains comparatively less magnesia than the average of outcrops at Mussoorie. Perhaps this is owing to greater resistance of the dolomite outcrops to the weather. It is easy to classify the limestones in the torrent beds; a mixture of better pieces which gave effervescence with cold acid contained 87 per cent. of calcium carbonate, a mixture of pieces which gave no effervescence with cold acid contained only 55 per cent. of calcium carbonate.

The latter mixture proved also to contain some proportion of calcium phosphate. The dark crumbling rock No. 2 near Jharipáni left a black residue after its solution in acid. This residue contained free carbon, which amounted to 0·1 per cent. in the sample. A great many specimens of the limestone gave when

broken a strong bituminous smell. That the drainage water takes up large quantities of lime and forms again incrustations has already been remarked. There is a spring at Sahansra Dhára, three miles east of Rájpur, which contains hydrogen sulphide in considerable quantity. The smell of the gas is noticed 20 yards from the spring. Silver coins placed in the spring get blackened, and lead acetate solution colors the water dark brown. Besides this hydrogen sulphide, the spring contains carbon dioxide, calcium carbonate, magnesium sulphate and calcium sulphate. The latter compound appears to be present in the largest quantity.

MAIPHAK AS A SUBSTITUTE FOR TEAK.*

TO THE EDITOR, "INDIAN FORESTER."

SIR,—The supply of teak seems to get less year by year, and as the demand seems steadily on the increase, it behoves those it may concern, especially the Indian Forest Department, to take steps to see if some other wood might not with advantage be brought into the market, that can compete with it in some of its good qualities.

I have for some years endeavoured to draw attention to a tree in Assam, that has several valuable qualities, and now beg to send you a small piece of it, together with outlines of the leaves and flower, in hope that it may be identified.

Reference I see is made, to a sample I sent some years ago, on page xiii of Mr. Gamble's "Indian Timbers;" apparently it belongs to the *Meliaceæ*.

I described this tree shortly in the series of our Assam timbers, in the "Tea Gazette" for July 7th. It is found semi-gregariously, and also singly, with bole of 30 or 40 feet by 5 or 6 in girth, and has a fairly rapid growth, and nearly straight clean stem. The bark is smooth, thin and greyish brown. Here and there at cracks a clear amber colored gum exudes and forms beads.

The sap wood is soft and white, well demarcated from the heart wood, which is yellowish when first cut, and turns brown on exposure. When dry, it is almost exactly the color of teak, with a very similar density and grain. If anything it is rather lighter.

It seems to stand exposure fairly, and to resist the attacks

* We have compared the specimen of wood sent by Mr. Peal with a specimen labelled E 3341, and described on page xiii of Gamble's "Manual of Indian Timbers" They are evidently from the same species.

Mr Gamble notes as follows—"E 3341 from N. E part of Sibsagar, Assam, called *Mipak*, is a soft reddish wood resembling that of *Melia*. It is evidently a useful wood for the same purposes as toon is used. It splits well, and is useful for shingles. Weight 27 lbs. per cubic foot" Mr. Peal writes that both the specimens and notes were furnished by him to Mr. Gamble.—[ED.]

of white ants, is easily propagated from seed, and grows rapidly, three and four rings per inch of radius for the first few years, and five to six afterwards. The wood is used in Assam for various purposes where lightness, strength and durability are needed. It is also largely used by the Singphós for supports to their floors.

There are many fairly good woods in Assam, but as a competitor with teak for furniture and fittings of houses, such as doors and window frames, I feel sure Maiphak has only to be more known to become popular.

The time seems near when teak will be one of our dearest timbers, the demand seems steadily outstripping the already limited supply, and if it is to be used as the backing for our "iron cased fortresses," God help all those who use it for the hundred and odd purposes it now subserves.

The foliage is very like *Cedrela Toona*, rather fewer leaflets on each stem, and they are rather more pointed, but it is at once known, if the leaves are bruised, by the strong aromatic smell, the leaf stalks are also reddish. The flowers are small, and clustered in masses at ends of the upper branches, and come out in August. They have five petals; three, four, or five seeds of glittering black, and size of BB shot, are in each seed case, and surrounded by a white and highly aromatic skin or aril.

Some few years ago I sent seeds of it to our Forest Department, and hear it was planted in the Kulsi reserve, but have not heard the result.

I should be glad to hear if the tree has been named or classified, and if it is known in other parts of India.

I will forward some seed when ripe.

S. E. PEAL.

Sibsagar, Assam.

FOREST PROTECTION AND TREE CULTURE ON WATER FRONTAGES, WITH THE VIEW OF PROVIDING A CONSTANT AND STEADY SUPPLY OF WATER, FOOD, SHADE, AND SHELTER FOR FRESHWATER FISH.*

THE question of pisciculture, its protection, and the protection of fisheries have been already discussed by so many able and learned gentlemen, that I should not have ventured to come forward if there had not presented itself to my mind a question in which I, as a professional forester, have a great interest, and one which I feel is of much importance to the success of pisciculture and to all freshwater fishing.

The value of the question which I have the honour to bring before you may not at first appear so great as it really is, but,

* By D. Howitz, Conservator of Forests, Denmark. Read before the Conference in connection with the Great International Fisheries Exhibition.

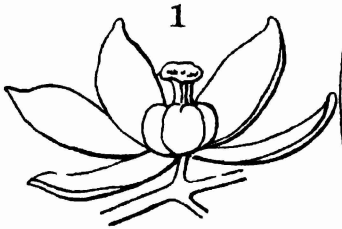
MAIPHAK.

Foliage ½ natural size.

Diagrams of flowers = 1,2,3.

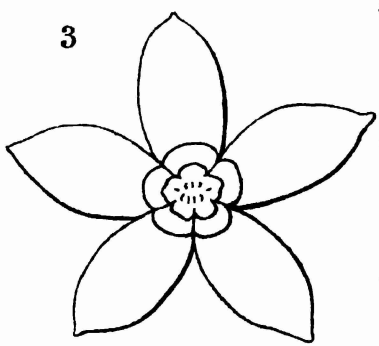
= enlarged about six times.

Terminal



1

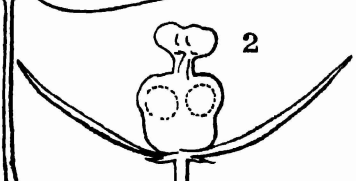
Flowers August



3

Seed natural size.

Ripe seed case, natural size.



2

Section of flower.

S.E. Peal.
1883, Assam.

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún, January 1884

C. Dyson Photo *C. G. Ollenbach Zinco*

while endeavouring to enlist your sympathies; I do so in the sincere hope that by the introduction of it at this Conference it may become a question of interest to all and a special subject for future legislation. It is the question of the protection, proper management, and cultivation of forests and forest trees in localities where are found the sources of creeks, rivers, and the supply of water to lakes and other fresh waters.

For Great Britain this question has its greatest significance with regard to future forest culture on barren heights and the cultivation of shade and shelter trees along watercourses. The greatest part of the forest land with which our question has to deal is in the possession of large land-owners, but as far as I can ascertain there are no laws in existence giving a guarantee for the preservation and proper management of these forests. Far more importance has this question for the British Colonies, America, and several other countries, where either the State, a number of persons, and in some cases nobody, owns the land in question.

That the forests regulate the flow of the water in watercourses, and ensure a steady supply during dry seasons, while they prevent sudden and disastrous floods, is a fact so often discussed and proved, that I need only refer to it here.

That the forests also increase the rainfall has often been disputed, and this question has of late years received considerable attention, particularly in France, but there is still a great deal of uncertainty about the exact extent of the effect of a forest on the rainfall, and it is only by very minute observations of forests, consisting of the same species of trees in various altitudes, that series of trustworthy results can be attained. Still there is no longer any doubt as to the effect of the forest in conserving the water that falls, or that the humidity of the air above a forest is considerably larger than that of the air of the open country. Experiments in the South of France showed that the rainfall in a forest as compared with that in the open country was in the proportion of 100 to 92·5, while the evaporation in the forest was only one-third of the evaporation in the open. The result of this is that the actual water received and retained from the atmosphere is nearly 50 per cent. greater in a forest than that received and retained by the plains. Numerous observations have also established the fact that the forests, as ready conductors of electricity, influence the current of vapours, and that their action is felt far above the actual height of the trees. Also that they condense the clouds into rain by lowering the temperature, and act as bulwarks against the severity of storms; all this we know by daily experience and observation. That want of forest protection may have most fearful results has been so often and sadly proved, and I need only remind you of the disasters caused by great floods and long droughts in Spain, South of France, Sicily, Chili, Peru, Mauritius, and many other

places, and you will grant the importance of the question. In the Murcia valley the river was reduced to a succession of stagnant pools, which during the summer heat developed malaria, fever, and miasmatic exhalations, detrimental to life and health, and furnishing but scant and bad accommodation for the few remaining fish. But as soon as the winter rains came, the river, in fact nearly all the valley, became a raging torrent, destroying life and property, and all because the forests on the ranges and mountains had been devastated, no legal restrictions protecting them. As a question of national economy, as a question of protection to life and property, and as a question of prosperity, forest protection has therefore the greatest claim to the attention of the Legislature. But to us as a means of yielding a constant supply of water, food, and shelter for the fishes, it has also great significance. The forest, with its numberless roots and decaying vegetation, retains the rain water and prevents it from rushing to the rivers and the sea, while it gives it off to these slowly and steadily. It acts like a great sieve and retains the fine particles of the soil, which the influence of the air and sun, the frost and rain, and the action of the numberless roots have decomposed, thereby fertilising the land and forming a layer of mould or humus, in which insects, worms, larvæ, and other animalcules live and breed.

In his most interesting paper on fish diseases, Prof. Huxley said that drought or flood did not seem to affect the *Seprolegnea*, but that a steady flow was beneficial to the fish.

Mr. Wilmot, in the following discussion, pointed out that the disease nearly always appeared where the regularity of the supply of water had been disturbed by the destruction of the forests.

I presume, therefore, that both these learned and practical gentlemen will agree with me in the importance of the forest protection as a means of preserving the health of the fishes.

The branchlets, leaves, decaying and decayed vegetation, produce a vast amount of nourishment for the fish, and one most agreeable to them. Each breeze drops into the water numberless grubs, caterpillars, beetles, flies, and other insects, the food most relished by the fishes, while from the banks and roots worms and grubs are constantly supplying them with delicacies.

The shade of the overhanging trees is also agreeable to the fish, and one needs only place a board in a stream and see the fish gather underneath it to be convinced of this. We all know that a shady deep pool is a good place in which to seek for fish, and have often observed the predilection fish have for the shady side of a stream. But not only as regards freshwater fishing can this be said. In Denmark it is a well-known fact that the best fishing is where a forest is close to the shore, and in particular where the trees, as is often the case in that country,

overhang the very sea. The shadowing trees have another and, perhaps, the far more important effect of preventing a large evaporation, and at the same time keeping the water clear and cool in summer, while on the same account the winter frosts do not deal so severely with them. In all forest country the changes of temperature are not so severely felt as in a treeless country or on the open plains, and the effect upon the water is even greater. It is a popular saying in Denmark of the forest streams, that they are cool in the summer and warm in the winter, this, of course, meaning that they present that feeling in comparison to the atmosphere. The forests not only regulate the flow of the water, but they purify the water. This is an experience often demonstrated in Australia in cases where streams have been polluted by wool-washing establishments. After having passed a few miles through a shady and dense forest the water will appear as clear and pure as it was above the woolwash.

I need not here enter upon more reasons for the conservation of existing forests to ensure a steady supply or to draw your attention to the danger in not protecting them by legislation. But I will draw your attention to the advisability of cultivating forests on places suitable for the supply of water, and especially along watercourses and lakes as means of purifying these, preventing too great evaporation, supplying food for fish, and providing these with shade against the rays of the summer sun, and shelter from the pelting rains, the hail and the tempests.

Salmon fishing and all freshwater fishing depend upon proper attention to this matter, and I feel certain that if the true causes were properly investigated where fish were said to disappear from a stream, in half the cases it would be found that the shade and shelter of the forests or protecting border trees had been taken away. It was said at the reading of Sir James Gibson Maitland's excellent paper on the "Salmonidæ," that it was not enough to place spawn and fry in a water, they must be provided with proper food, and the best means to do this is to preserve the border trees and ensure a steady supply of water and food by preserving the forests from whence the supply of water is derived. But, as before remarked, it is not enough to preserve the present forest. New forest must be cultivated on the barren ranges, and many a stream, now nearly empty during dry seasons, will be re-filled and soon teem with fish and food for the many. So far for the principle of the conservation of the forest. I will now briefly mention the most suitable trees and their culture. But before entering upon this, I must draw your attention to the important condition to be observed in the management of such forest areas, as are preserved for the sake of conservation of water. *This condition is density.* In the dense shade of a well-closed forest are developed all those atmospheric conditions on which depend the greatest effects of the forest in

regard to climate and water conservation. The so-called periodical thinning out in these areas should be carried on with the greatest care, and might with advantage be nearly dispensed with, if the economy of the management would permit it. The result would be, besides the effect upon the water conservation, that tall straight trees would be reared, yielding timber most valuable for all practical purposes. Nature itself would do the thinning out, and do it in a better way than we could hope to do, while the ground would be kept moist and in a state favorable to the decomposition of vegetable matter. It is desirable therefore to frame regulations regarding such forests, deciding the minimum to be preserved of the number of trees per acre, due regard being of course paid to age, species, altitude, and locality. For these reasons it is highly important that *all such forests*, whether private property, commons, or belonging to the State, *should be placed under the control of the State.*

The different trees have naturally a different effect as regards conservation of water and production of food and shelter for fish, as I will here briefly point out. To simplify matters we may divide all forest trees into two large groups, the deciduous and the evergeen trees. The deciduous trees of which, as far as Great Britain is concerned, the oak, elm, beech, plane, larch, willow and poplar are the most prominent, have a decided advantage over the evergreens. I need not here enlarge upon the fact that the full shady foliage during the summer is far more effective in preventing a large evaporation, and that the branches of the trees of this group are more spreading than those of the other. The energy of life seems to be far greater in these trees towards effecting our objects, and for direct border trees to a watercourse they are undoubtedly the best suited. The great amount of foliage and branchlets yearly thrown by these trees forms a very prominent factor in the economy of nature, and their decaying vegetation is full of teeming life and food for fish.

That this group is eminently suited for water conservation, was illustrated in a forest in Denmark, where an area of firs and pines was cultivated with beech and oak. After a lapse of about fifteen years a mill-stream, which during the time of the evergreen trees had dwindled down considerably, assumed such proportions that the irrigation of a considerable area was effected by it, besides supplying the mill with abundance of water. As regards the evergreen trees, the first cultivation of barren ranges or high plateaus might advantageously be undertaken with these on account of their ability to resist the severity of the climate in those exposed localities, and to grow on stony and poor soil. But even on rocky ground and in high altitudes the larches, birches, and other deciduous trees will often do well and serve better for the end which we have in view, the water storage and the pisciculture.

In such localities, where only the most hardy trees can be

reared, it would be practical to cultivate along the watercourses, in the valleys and ravines, or any lower ground, a few rows of deciduous trees as soon as the other trees had attained sufficient height to protect them from the storms and the frosts. Several objects may be gained by doing so. First, the shade, shelter, and other beneficial effects for the fishes; secondly, that most valuable timber could be reared, as these trees have, as a rule, a greater preference for damp and moist localities than the evergreens; and thirdly, because the deciduous trees permit more freely a luxuriant undergrowth of shrubs and annuals. All freshwater fishermen will agree with me in the advantage of having a good growth of annuals as watercresses, nettles, &c., near the bank, and have observed that during feeding time the fish always seek such places. There is a vast variety of shrubs and annuals, that might easily and with great advantage be introduced and grown on the river banks, but it would be outside the bounds of this paper to enter fully on the theme. However, I may only mention that many fodder plants and grasses from other countries might be a source of wealth to the population, and greatly benefit the fish as well as the owners of the land, if cultivated on the banks. The prickly Comfrey, *e.g.* (*Symphaytum asperrimum*) which yields such a splendid forage by its abundant foliage, and many others, are easily reared both from seed and cuttings, and should do well in the low lands, while on the sandy beaches, near the outlet of rivers and creeks, the cabbage radish (*Pringlea antiscorbutica*) would cover these barren and desolate places with vegetation, and furnish an object of merchandise by packing them for the use of fishermen and sailors in the Arctic regions. The plant when cooked is a good substitute for cabbage, and has a most wholesome effect on persons suffering from scorbutica.

By a judicious forest management, which I will not enter upon here, the land can be kept covered constantly, and always in a state favourable to the purpose of storing the water. That many of the evergreen trees may be of great importance, and particularly where they are better suited to clime and soil, I will not deny. The Australian Eucalypts, which have such a beneficial effect on the health of man, may also serve well for pisciculture, but as far as I know, no experience is yet at hand with regard to this. Still I doubt if these trees might not do more harm than good by being planted on watercourses, on account of their great drying properties. In warmer countries, the place for these trees is where stagnant waters during summer are breeding places for fever and ague. The cultivation of the borders of watercourses has also a great significance to us, and it is here that the deciduous trees must be mainly utilised. The belt need not be very broad, say half a chain wide, and planted with good-sized plants at the rate of from 800 to 2000 per acre, according to their age. Even a double row of trees

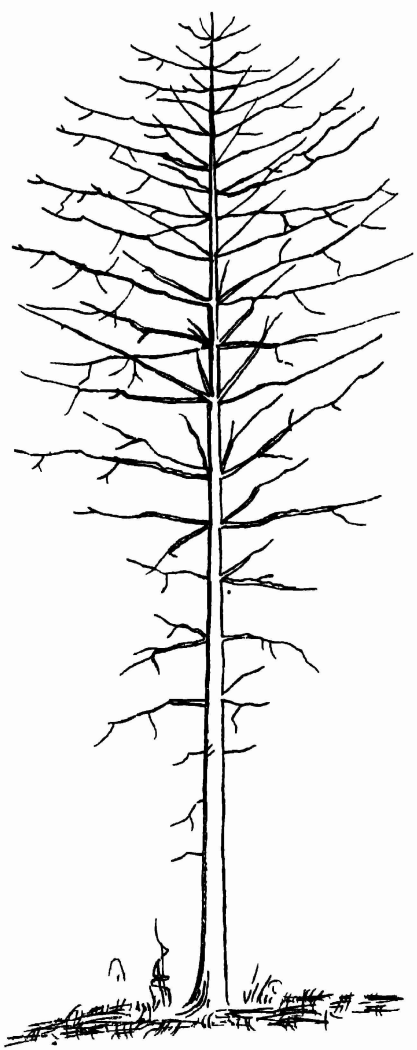
would be a benefit, but it is important that both sides of the stream should be planted instead of cultivating twice the distance on one side. This being done with the object of providing a perfect shelter in some place, and valuable observations may be obtained by doing so. A great many American and other foreign trees might well be introduced, as, for example, the Swamp Cypress (*Taxodium distichum*), a great tree yielding a finely-grained timber, hard and durable, and the Leverwood tree (*Ostrya Virginica*), which besides excellent timber furnishes a relished forage from its rich foliage; these, and a great many more, might have a good effect on the river fishing besides other advantages. But it is particularly the willows to which our attention should be drawn. The preference which these trees have for water, and particularly for running water, is well known, and points directly to the practicability of placing them in those localities so well suited for them. The fish like willows, and I have often times in Australia seen the best fishing places close to where some weeping willows (*Salix Babylonica*) had taken the place of the indigenous and even more shady wattles (*acacias*).

The yearly consumption of osiers in England is far greater than the national supply, and as the basket industry is constantly on the increase, it would also on this account be advisable to further the cultivation of the osier willows. For light, sandy banks, the best willow should be *Salix purpurea*, and, as it is so easily propagated, it will well repay the cost of cultivation, besides binding the banks, making them firm, and adding to the health of the locality as well as that of the water. For more clayey soil, *S. viminalis* and the now celebrated *S. caprœa*, so much sought for powder factories, should be the best. The cuttings must be taken from the one to two year old shoots, and be put 1 to 1½ foot apart, in double or treble rows 2 to 3 feet apart, care being taken to leave only half inch or less above ground.

There are many localities where comparatively valueless land, close to the mouths of rivers and canals, might be made highly profitable, at the same time as the cultivation of it with the before-mentioned trees and plants would improve the state of the fishing, and, before placing spawn and fish in any water, I consider it important to pay great attention to this question. Where few or no trees exist it will be necessary to cultivate them, and I feel certain that such proceeding will enhance the chances of the success of pisciculture. I will not here enter further upon the practical details of the question. These are bound to vary with the locality, and the local foresters will know how to deal with them.

In drawing the attention of the Conference to this question, it is with the sincere hope that it may enlist your sympathy, and that the public opinion may be won for it. That it is important for all freshwater fishing is evident. That is one more rea-

SIMAL (BOMBAX MALABARICUM).



Feet	Branches
80	
77	5
75	5
73	3
71	3
70	3
68	4
65	4
63	5
60	4
56	5
52	5
48	5
43	5
38	4
34	3
30	3
25	3
21	2
17	1
12	1
9	0
5	0

Litho T. C. Press, Roorkee. THOS D BONA, Supdt

son added to the many why we should regard the forest as a precious heirloom to be deeply revered, properly used, and, through careful maintenance, descend improved and enriched to posterity.

GROWTH OF *BOMBAX MALABARICUM.*

TO THE EDITOR, "INDIAN FORESTER."

SIR,—To-day I felled a simal tree that had such very remarkable persistence of the branches, that I carefully counted them and measured the stem.

Simal here throws out branches often very regularly in fives radially at every 4 or 5 feet up the stem; in the forest the lower ones soon die off. In this case there were 22 nodes from whence branches had sprung, and some remained on 20 of them.

Total height,	...	... 80 feet.	
Girth at 10 feet,	...	... 6 „	
„ 20 „	...	... 5 „	
„ 30 „	...	... 4 „	6 inches.
„ 50 „	...	... 3 „	

Growth by rings, 10 or 12 years. Distance between nodes and the number of branches, as per sketch. Largest branch, 20 inches round. It was growing amongst tea bushes and sheltered by forest not far off.

Five branches had grown regularly from every node; 37 had fallen and left scars; two lowest and some upper branches were dead; 68 or 70 remained on alive.

SIBSAGAR, ASSAM,
January, 1884.

S. E. P.

PARAFIN OIL FOR ORCHARD TREES.

AN article in November's Number of the "Nineteenth Century" gives a bad account of the orchards at home. The author states that in most, the trees have a very wretched appearance, being covered with lichens and dead branches. He has discovered that an application of Parafin oil to the bark kills the lichen, and that the tree then recovers its health. He goes on to recommend to farmers the planting of orchards, which he says pays better than corn. Let us hope the poor farmer will find it so.

F. B. D.

JJ. Reviews.

REVUE DES EAUX ET FORETS FOR SEPTEMBER, 1883.

This number contains two papers of great interest. The former, by M. Ed. Blanc has for title "The Landes, their Past and Future."

The author informs us that a M. Dupouchel started an ingenious theory, having for object the reclamation of the Landes of Gascony. This object was to be effected by diverting the course of some rivers coming down from the Pyrenees, so as to bring to these barren plains the soil washed down from the hills. M. Dupouchel estimates that the area, which would thus increase in value and fertility, would amount to about one million hectares, and that the cost of the undertaking would not be more than 24 or 25 millions of francs. He further states that the only culture which now exists is that of pine, that its timber is of little value, and that oak, which is the most valuable timber tree in France, is not indigenous in the region.

M. Blanc shows that M. Dupouchel has based his proposals on wrong data. The total area of the Landes amounts roughly to one million acres, but all this extent of land cannot benefit from M. Dupouchel's scheme. First, there are the Dunes, to which, as they consist of hills, this system of irrigation cannot apply, without considering that they must remain under a special system of protection. The *Maremme* would not reap any benefits from it, as the cultivation of the cork oak (*Q. occidentalis*) already yields ample profits. Neither can the State forests, which are inalienable, be included, nor can the areas covered by villages and hamlets, lakes, ponds, already fertile valleys and tracts of country, like the *Chalosse*, and hilly country. By deducting these the area is considerably diminished. M. Blanc further considers that the cost would amount to quite 40 or 50 millions, for a network of roads would be indispensable. These would be very expensive to make on account of the total absence of stone throughout the Landes. He also says that M. Dupouchel's estimate of the increased value of land is far too high, 5 to 6,000 francs per hectare,* whereas land of excellent quality and favorably situated is sold constantly at 1,500 to 2,000

* 2½ acres nearly.

francs per hectare. He considers, therefore, that the increased value, *i.e.*, the difference between the actual and the future value, would not be more than 600 to 1,000 francs per hectare.

The author then gives a detailed description of the different portions of the Landes as they were and as they now are. There are few persons, who are not aware that the Landes to-day are no longer what they were ; the country described in so graphic a manner in *Maître Pierre* is no more the same. The bare marshy desolate plain formerly known as the "*lande rase*," the bleak sandy hills known as the "*dune blanche*" are now things of the past. With them have disappeared that once necessary mode of locomotion—stilts. Now, thanks to Brémontier, who originated the work, the country is one mass of forests. Those everlasting pines, which meet the eye of the traveller at every step, are no doubt monotonous, but along the dunes the scenery is not devoid of a sombre beauty. The Atlantic surges up in long lines of waves, which break in a mass of white foam on the sandy beach. In the forests the ground is covered with a dense underwood, in the midst of which the graceful heather puts forth its lovely flowers, the trees are decked out with little pots to receive the flowing resin, and ever and anon a pretty lakelet will suddenly burst into view with a hamlet sleeping on its peaceful margin.

Thus it is evident that the soil of the Landes is pre-eminently adapted for the growth of pine forests, and the oak, in spite of what M. Dupouchel says to the contrary, is certainly not absent, and attains splendid dimensions, as can be seen from the few fine trees left in the neighbourhood of certain villages. As M. Blanc says :—

"The Landes are well suited for the cultivation of the oak; here then it would be easy to obtain, rapidly and without any efforts, finer and more numerous oaks, than in a much longer period in all the forests of Eastern France put together."

But what oaks exist are now of no value on account of the want of means of communication. The inhabitants who earn a livelihood by the extraction of pine resin, look upon all other trees as weeds, that are only fit to be felled and put out of the way to make room for the pine. They have but few fields, barely enough to satisfy their wants. The only manure which they can obtain is that which they get from the *soutrage*, *i.e.*, right of lopping the brushwood in the forests.

Having proved the possibility of growing fine forests of pine and oak, M. Blanc points out that the pine trees ought not to be tapped so extensively as they are now, but only a few years before their exploitation. The growth of oak must be encouraged and *soutrage* abolished, and the Landes will then soon be able to supply timber in large quantities.

Means of export must then be established. Roads and rail-

ways would at present be too expensive, so the author's proposals amount to this :—

The long chain of small lakes along the eastern foot of the dunes south of Arcachon ought to be utilized to make a canal from the Bay of Arcachon to Bayonne. Later on another canal should be made, connecting Arcachon with Bordeaux. Speaking of the Arcachon-Bayonne canal the author says :—

"It would be 124 kilometres long, 106 of which would be in the department of the Landes, and 18 in that of the Gironde. The lakes are, most of them, connected with one another. By taking advantage of these natural communications, as well as of the difference in level of the lakes, there would be no difficulty in joining them by means of a navigable channel.....This new canal would serve not only for the export of timber, but also for that of cork from the *Maremme*, of resinous products from the *Marensin*, of iron from the foundries of Castet and Uza, and of all heavy material for which transport by water is evidently preferable to that by rail. It would also serve to bring stones from Bayonne, and thus supply the means for the construction of roads, and lastly, mineral manure, which would be vastly superior to that obtained from the soutrage, might be brought in and that disastrous practice abolished."

There is no doubt that this would prove of vast benefit to France, for the foreign forests which are now supplying it with wood are getting exhausted, and the country itself is at present far from being able to satisfy its own wants. By the cultivation of the pedunculate oak, and an improved system of export, the requirements of the vine growers of Burgundy and Bordeaux for the manufacture of casks might be met, while the pine from the Landes and the other recently wooded countries like Auvergne and the Alps would furnish a large quantity of timber.

The second paper is a translated extract from a German Forest periodical, and gives an account of the visit of the Austrian Minister of Agriculture to the works of protection and re-afforestation in the Alps of Dauphiny.

It is not necessary to go into the details of the report, which gives a description of the different operations which have been carried out, and which have put a stop to a number of dangerous landslips. But it is interesting to note that what they admired most were—(1), the system of having a separate independent establishment for these works ; (2), the numerous inspection bridle-paths ; and (3), the temporary nurseries which have been established at all convenient places. What the author says about these nurseries is worth quoting :—

"The necessary planting material is prepared in temporary nurseries, which have been made at all elevations at any spot containing fertile soil, and measuring at times not more than 10 square metres, and usually these nurseries consist simply of a single bed one metre

broad. They need no enclosure, cost very little, and ensure the success of the plantations by giving the advantage of a short transport, and chiefly by enabling the plants to grow up in a soil and climate identical with that in which they will have to live. Landslips are prevented by means of small drains which are either open or covered with flat stones."

FOREST PROGRESS REPORT FOR BRITISH BURMA 1882-83.

THE Burma Forest Act XIX. of 1881 had effect from the 1st of July, 1882, together with a series of rules passed by the Chief Commissioner under the provisions of the Act. The Forest law now in force having been prepared and passed after some years' experience had been gained in the working of the general Indian Forest Act, may be considered the best forest enactment in India. The rules passed by the Chief Commissioner in July 1882 are divided into five sections relating to—

1. The protection of reserves from fire, the prohibition of shooting in reserves at any time without a license, and not at all during the fire season, whilst pheasants, jungle-fowl, partridges, quails and hares are protected during the breeding season.
2. The extraction of reserved and unreserved trees and forest produce. Excluding teak reserved by the Act, the number of reserved trees has been reduced from 16 to 6. The rates have in fact been raised more than double in all cases, and the power of granting free licenses for reserved kinds confined to Commissioners of Divisions and Conservators of Forests. The trade license system has been extended to all unreserved timber extracted for sale and removed beyond a certain distance from the forests.

   No Cutch trees (*Acacia Catechu*) are allowed to be cut below 3 feet in girth, the rate levied being Rs. 20 per cauldron of 12 gallons. The license for wood-oil prohibits the tapping of Kanyin trees (*Dipterocarpus lævis*) under 7 feet 6 inches in girth, and limits the number of places in which such trees can be tapped. In Eng (*Dipterocarpus tuberculatus*) and Thitsee (*) under 3 feet in girth are also protected from tapping.
3. The control of timber transit, in which provision is made for the registration of hammer-marks.

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* The name Thitsee is not given in Kurz' Flora, so we cannot identify this tree.—[ED].

4. The salving of drift timber. A 'log' is defined as meaning a fairly good piece of timber not less than 18 feet long and 6 feet in girth. Salvage rates are fixed for all the Burmese depôts.
5. The powers of Forest Officers under the Act. These rules were revised in January 1883, the most important changes being—the reduction of the duty on foreign timber floated down the Salween to one-half per cent. *ad valorem*; the exemption of the Arakan division from the provisions of the rules; and a considerable reduction in the fees for the renewal of the registration of hammer-marks. Departmental directions for the guidance of Forest Officers and for the information of the public were also issued.

Owing to the alteration of procedure for the formation of reserves by the new Act little was added during the year. The estimate of 3,474 square miles made by Mr. Brandis has now, however, been almost reached, but the Government of India advises the selection of further reserves as long as valuable teak areas are available, which can be reserved without inconvenience to the people. Measures have been taken for the formation of Cutch reserves in the Thayetmyo district, and Mr. Hill says that —"The importance of maintaining a continued supply of Cutch trees for the support of an industry that gives occupation not only to a large number of Burmans residing within British territory, but also to immigrants from Upper Burma, has often been remarked upon, and the Government of India have specially pointed out the urgency of assuring the reproduction of Cutch by natural or artificial means. Throughout the Cutch-producing parts of the Thayetmyo and Prome districts, the powers of natural reproduction of the tree, both from seed and from stool, are so great, that the majority of the toungya clearings are thoroughly well-stocked with a young growth of Cutch; this young forest, however, is not allowed to attain an age of more than 10 or 15 years before it is cleared by the toungya cultivator, whose rotation in many instances even falls short of this limit. For the production of Cutch trees of sufficient quantity and of an age suitable for the manufacture of Cutch, all that is required is the reservation of a sufficient area of these old toungya grounds." Steps have also been taken to demarcate village forests in the delta of the Rangoon river, in order to guarantee a sufficient supply of fire-wood to the large villages there.

Para. 6 of the resolution by the Government of India runs thus—"The progress of the forest survey, conducted by the general Survey Department of India, has so far not been satisfactory, owing to the exceptional difficulties which were met with at the commencement of the operations. It has now

been decided to survey the forests on a modified 4 inch scale, which will enable the survey party to turn out about 300 square miles annually, at a cost of Rs. 135 per square mile, debitable to the Forest Department." The following extract from the Deputy Superintendent's report will show what impression the forests left on a new comer. "The features are of an intricate nature, consisting of a few high ridges, the interlying vallies being cut up by innumerable watercourses, which are generally so deep, wide and thickly wooded, that it is a most difficult matter for the surveyor to distinguish between the large and small ones, and therefore he has generally to follow up the courses of all in order that important features may not be omitted. The forest is extremely dense, almost impenetrable, every ray either for the traverser or plane-tabler has to be cleared more or less, so that the work progresses literally by inches. The only clearances are those made by Karens, which are few and far apart. After a time the silence and monotony become so painful, that the longing for a change is beyond all description. The Burman cannot endure this, and it is only the European or the Hindustani who has sufficient perseverance to plod his weary way. For three months a fog quite as dense as any experienced in England, out of London, overhangs this desolate region. It lifts at about 10 A.M., up to which hour there is a constant drip, drip from the trees, and the undergrowth is reeking with moisture, the bad effects of which none but people of the strongest constitution escape." From this it would appear that the Deputy Superintendent is not in harmony with his surroundings. We think he has painted forest life in colors far too black, although fever is undoubtedly very common. During his next season's work let him devote his leisure hours to the study of the luxuriant flora, or to that of any other branch of natural history, and we venture to predict that the monotony will disappear, and that he will find jungle life has a peculiar charm of its own which endears it to every true Forester.

It appears from the Resolution by the Government of India that the Working Plan Branch, at the present rate of progress, will take over 100 years to draw up plans for the whole province. Operations were confined to 24 square miles in the Tharawaddy Division, and at first it was intended to carefully count every tree in this area. This might be advisable in certain forests, such as in some of the well-stocked and easily accessible sál forests of Oudh for example, but in Burma the Conservator is of opinion that—"The difficult configuration of the ground and the almost impenetrability of portions of the forest are sufficient so as to retard the work as to make it inordinately expensive. In order to expedite the work a system of linear surveys was substituted, and in this way 578 acres, or 4 per cent. of the total area, was correctly surveyed and valued. Although this is a very small percentage, it

seems sufficient considering the very poor average of teak trees to the acre contained in our natural forests. In the North Bilin block, including unsound trees and seedlings, only 15 teak (of which 9 are below 1 foot in diameter) are found to the acre, and the South Môkka block contains on an average 17, of which 11 are below 1 foot in diameter. The average number of all kinds per acre is 33 to 35, bamboos for the most part completing the forest." In the dry forests the principal associates of teak were found to be *Lagerstræmia Flos-reginæ*, *Xylia dolabriformis*, *Dipterocarpus tuberculatus* and the Myinwa bamboo (*Dendrocalamus strictus*), whilst in the moist forest occurred *Dipterocarpus lævis*, Mygin (?) and Thitya (*Shorea obtusa*) together with two bamboos, *Bambusa polymorpha* and *Cephalostachyum pergracile*. It was estimated that in the dry forest, teak takes 110 years to attain a girth of 6 feet, whilst in moist forest it requires 105 years only, but the data on which this estimate has been made are insufficient, and rings on a large number of stumps will have to be counted before any satisfactory conclusion can be arrived at.

Fire protection was not so successful as in the previous year, the area which it was attempted to protect being increased 16 per cent. in order to facilitate the extension of the teak toungya system, whilst the area actually protected was only 1 per cent. more than that of last year. We notice that extensive stretches of Kaing grass much assisted the spread of a fire in the Tennasserim circle. Perhaps it might be possible to burn these stretches before the more valuable jungle had become inflammable.

During the year the regular plantations have been increased by 21 acres only, successful toungya plantations by 651 acres, at a cost of Rs. 9 per acre, and indifferently stocked toungya plantations, &c., by 449 acres, at a cost of Rs. 8 per acre. These additions consist almost entirely of teak. An attempt has been made to start Cutch toungya plantations, which will we hope prove as successful as the teak ones. 400 acres of teak-producing forest, covered with flowering bamboos, were successfully treated and are thoroughly well-stocked, but Mr. Hill says that—"The clearing and burning of such tracts cannot be done until several years after the flowering has taken place. It may be useful to burn the forest the first year with no other object than to destroy as much of the bamboo seed as possible, but before the ground can be sufficiently cleared for planting several years must elapse." The cultivation of various exotic plants and trees has been continued, but the only promising experiments are those with Mahogany and the Paper Mulberry.

Colonel Seaton makes some interesting remarks on the state of the natural reproduction of teak in a part of the East Salween division. He says that—"On hills where teak occurs in bamboo jungle, and along the edge of the dry forests on the

crests of ridges, seedlings appear to be plentiful, and promising trees of the 3rd class in fair proportion along the banks of the Thaungyin, the teak having to struggle with a large sprinkling of moist forest trees, reproduction is in a very bad state. This is doubtless in the first instance due to the indiscriminate girdling of all marketable trees which took place near the river many years ago, as evidenced by the stumps largely outnumbering the total of the first three classes, 17,596 teak and 6,195 other trees were girdled, all of which save 4,711 trees were outside reserves.

More than 48,000 tons of teak were extracted, being an increase of 55 per cent., due to the high rates obtainable, whilst 50,000 tons of other timber were taken out, or a falling off of 17 per cent., by reason of the number of reserved trees being reduced from 16 to 6 and no record being kept of the quantity of unreserved timber cut for use near the forest. Owing to the introduction of the new rules in the middle of the year, the timber account as given in the report is somewhat difficult to unravel. Some Pynkado railway sleepers were sent to Calcutta, and in spite of the small profit realised, it may be found advisable to continue exporting them in view of the large railway extensions about to be made in India.

Minor forest produce realised Rs. 80,000. In Tennasserim, cardamoms continue to be collected by Karens free of duty. 1,500 cwt. of the bark of *Rhizophora mucronata* used for tanning purposes, and 50 cwt. of the bark of *Tetranthera laurifolia* for mixing with salt of local manufacture were exported to Rangoon. In Pegu Rs. 70,000 were received from Cutch licenses, and it is estimated that 168,000 trees were boiled.

150,000 tons of teak, valued at Rs. 140 lakhs, were exported as compared with 130,000 tons in 1881-82.

Although there was a loss of Rs. 2½ lakhs due to the reduction of duty on foreign timber, the surplus was 12¾ lakhs, or nearly 2 lakhs more than that of last year. The large receipts are chiefly due to the high price of teak prevailing during the year.

A 1st Class Forest Bungalow is being built at Toungoo, but we cannot discover from the report how much it will eventually cost, although the sum of Rs. 11,000 has been expended on it during the year under review.

A number of clearances to admit of the passage of timber rafts were made in the Tavoy river and the Méke stream, by means of 1,200 lbs. of dynamite. In the Sittang below Toungoo a number of snags were cleared away by a special party employed for the purpose.

Ransome's steam tree-feller obtained from England last year, has not proved so useful as anticipated. An experiment to clear a piece of land adjoining the Magayee plantations was not a success, the machine requiring constant little repairs, and the labor incurred in taking precautions against trees falling on the

feller rendered the work expensive as if done by hand. It is, however, as yet too soon wholly to condemn it, and it will prove more useful in cutting up logs than in felling trees if such work can be found for it.

DR. HOUGH'S ELEMENTS OF FORESTRY.*

IT is one of the misfortunes of Indian life that books are novelties in India long after they have been reviewed and have taken their places (if they are worth it) in the libraries of Europe or America. The misfortune is the greater because it might be helped. Communication with India is now comparatively rapid; but the fact is that the wants of the small European population are so varied, that Booksellers do not attempt to supply any but either directly professional—Military, Engineering and Medical—books; or just such literature (selected on what principle it would be interesting to know) as they think likely to sell.

It is thus that Dr. Hough's book is a novelty. Like all the publications more or less directly connected with the Agricultural Department of the United States, the book is well got up, full of facts and of information according to its lights; it has also abundant and extremely well executed illustrations, always introduced just where they are wanted. Nothing is more remarkable in the proceedings of the Washington Agricultural Department, nothing more worthy of imitation in India, than the way in which the latest and most reliable information connected with Departmental objects is systematically diffused at a cheap rate, and so that every one can obtain it, and so that no agriculturist can complain that he is not speedily informed of all that concerns the successful pursuit of his business. The chemistry of wheats and other grains, the value of manures, the properties of grasses and fodders, the facts about ensilage, the natural history of insect destroyers of crops, these are among many subjects on which excellent publications have been issued; and it is not too much to say that this book on the Elements of Arboriculture is a worthy compeer in nearly all respects. It is *called* a book on Forestry, but in reality—writing for America and its people—there is unfortunately at present no real demand for information regarding Forestry in its wider aspects. Until a country awakes to the fact, that a steady production (in large quantities) of building timber, is not to be had on other terms than those of reserving to the State or public control, large well situated forest estates, and

* THE ELEMENTS OF FORESTRY · designed to afford information concerning the planting and care of Forest trees for ornament or profit, &c., &c. By F. B Hough, Ph D Cincinnati, R Clarke and Co, 1882.

can by no means be accomplished by the most liberal planting of groves, parks and individual trees about private estates, so long the management of forest estates on a defined plan, cannot excite much attention. The book before us does indeed give a brief account of continental forestry, but explains neither its reasons nor its objects,—for example why it is that high forest is better than coppice for State purposes, and why the "natural system" is made so much of. Not one of all the problems that arise directly the management of forests, *as such*, is contemplated, and which are illustrated popularly in such books as that excellent little work of M. Puton's (of which a rough translation has appeared in this Magazine), is so much as alluded to in Dr. Hough's book. A little detail is indeed given about *coppice* forest management, because this—the "petite culture" of forests,—is always to be found even in countries which have no State forests. But the book would have been much the better for some such additions as M. Puton has given, and some proposals for a systematic management and account keeping in coppice forest estates. The system of 'selection felling' (*Jardinage*) is also alluded to, but nothing is said as to when, where, and why, it is adopted.

The only way in which this book differs from English Arboricultural books, as far as its scope is concerned, is in the fact, that it does contain *something* about forests, as such, and also deals with forest fires, and also there is some disposition shown to think more of planting *areas* and less of individual trees than usual.

Among the opening chapters, the second describes *soils* very much as usual. We doubt, however, whether the description of loam, sandy loam, &c., is an improvement on what is to be found in the older books.

Under the head of 'calcareous' soils also we look in vain for anything that will indicate, what proportion of lime should exist to enable us properly to call the soil "calcareous." "Alkaline" is hardly a class of soil of the same nature as argillaceous, siliceous, &c. But perhaps in America, there may be a special convenience in so dealing with soils most affected by the deleterious efflorescence of soda sulphate. In India the description would be very different.

The Chapter on Meteorology and Climate is excellent, and the paragraphs (73, 74, &c.) on the effect of woodlands, particularly so.

The writer then passes on to *reproduction* of trees from seed, and includes practical information regarding the harvesting and storing of tree seeds, and on the time of sowing, and on the vitality of different kinds of seeds. Next we have a brief notice of other methods of propagation, by layers, cuttings, grafts, &c., and details as to planting in rows, triangles, quincunx and in other forms. The 7th Chapter deals with the struc-

ture and functions of the various parts of growing trees ; the illustrations here are particularly good.

Then follow the three Chapters (VIII., IX. and X.) which constitute the 'Forestry' part of the work. Chapter X. we have alluded to ; it is the one in which a brief account of Continental Forestry is given, and includes (what we did not before mention) some account of reboisement works, and the planting of 'dunes.' Chapter VIII. gives some ideas regarding what we call "Forest Economy."

The question of profit is dealt with rather feebly, so at least it will seem to those who remember M. Puton's strikingly clear illustrations, and the convincing arguments in J. Clavé's *L'Economie Forestière*, a popular but valuable little book, which does not appear to have come under Dr. Hough's notice. The usual statistics are given with regard to the proportion between forest and total area in different countries, and a series of concise and interesting paragraphs explain the timber resources of the different American States.

Chapter IX. is devoted to a brief account of (what appears to the Indian Forester the imperfect) legislation of the United States, regarding forests, which amounts to a "Timber Culture Act"—granting leases of 'waste' land, with a view to timber trees being raised on the grants along with agricultural crops—and a few Acts attaching special privileges to the planting of trees ; while the Acts of 1878 for the sale of timber lands in California, Oregon, Nevada and Washington territory appear to us little short of disastrous.

The Chapters on ornamental planting, on hedges and screens, and shelter belts, and planting along railroads, leave nothing to be desired ; and the same may be said for the series of Chapters which follow, on the cutting and seasoning of wood, on wood-fuel, charcoal and wood-gas. But the progress of this class of information is interrupted for the introduction of Chapter XV. on forest fires, XVI. on injuries by pasturage and wild animals, and XVII. (with its unequalled wood-cuts) on insect-ravages. Then the author returns to timber industrial questions, and goes on with processes for impregnation and rendering timber durable and hard, with the products of the conifers, viz., resins, turpentines and balsams, with the manufacture of paper from wood-pulp, and with the production of tanning barks and the extraction of their valuable principles.

The rest of the book is occupied with descriptions of particular species of trees ending with the American conifers. The whole is brought to a close with a Chapter on the special forms of tree planting in Kansas and Nebraska. It is a pity that the book no where deals with the practical means of overcoming difficulties that occur in attempts to plant up dry, rocky, sandy or saline soils.

REPORT ON THE ADMINISTRATION OF THE METEOROLOGICAL DEPARTMENT OF THE GOVERNMENT OF INDIA IN 1882-83.

HENRY F. BLANFORD, F.R.S., *Meteorological Reporter to the Government of India.*

SOME topics of general interest are in the following briefly referred to.

Solar Physics.—A large photo-heliograph, suitable for taking pictures of the solar disc, 12 inches in diameter, has been supplied to the Dehra observatory ; and some additions have been made to the smaller instrument, rendering it capable of taking pictures 8 inches in diameter.

The variable state of the atmosphere renders it difficult to determine by means of thermometers the comparative intensity of the solar radiation. The atmosphere of Calcutta, where observations with Stewart's Actinometer have been carried on, is but ill-fitted for operations of such delicacy. Arrangements have been made for observations in the clear atmosphere of Leh, 11,500 feet above the level of the sea, in an extremely dry climate, with an average annual rainfall of two inches.

Snowfall in the Himalaya.—The dry north-west winds of Upper India are expected to continue during the spring months, but at times they are prolonged into July and August. If they are, then they delay the moist current of the summer monsoon. The south-west monsoon may be making good progress up the Bay of Bengal, may be sending its rain-laden clouds well up the country, when suddenly away up in the north-west corner an opposing force discloses itself, the moist wind is beaten back, and a dry north-west breeze takes the place of the moist south-east current. In 1876 Mr. Blanford observing these conditions, thought that the copious snowfall of the previous winter might have been the cause. The heavy snowfall of 1877-78 was again followed by a retarded rainy season in 1878. In fact every additional year's experience has tended more and more to bring into prominence the importance of the condition, extent and persistence of the Himalayan snowfields. Efforts are being made to obtain trustworthy information on the state of the snows in the Himalayas for the future every year.

A fall of snow in the hills is followed soon by a rise of pressure over the mountains, and by a steady wind over the plains from north, and further on from the north-west. This explanation of the north-west winds holds good for a certain time, but when the north-west winds endure for an exceptional period, an additional moving power must be looked for. It has been found that a vast area of Central Asia north of India has in July a much higher pressure than in January. The overflow from these regions, once diverted into a southward channel through

the agency of the snowfields on the Indian side of the Himalayas, may continue for a longer period. The snowfields have in this case invited an action, from the trans-himalayan source, in the same direction as the ordinary winds of the spring months, but more powerful, and more lasting than the direct influence of the snow cover by itself.

The temperature of Northern India (Mr. Hill's Report.) With the exception of some remarkable regions of abnormal coolness, the mean annual temperature in India increases from the coast steadily towards the interior, that portion which lies within the tropics having, however, a higher temperature than northern or extra-tropical India.

The annual range of temperature varies within the limits of India from only 40° at Bombay to nearly 90° at Mooltan.

Chart of average rainfall of India.—A large rainfall chart of India* is in course of preparation. It is on a scale of 64 miles to the inch, the first map which was compiled by Dr. Brandis having only been on a scale of 224 miles to the inch. There will be the following tints representing rainfall—

below	5	inches.
of	7·5	,,
,,	15	,,
,,	25	,,
,,	35	,,
,,	45	,,
,,	60	,,
,,	85	,,
above	100	inches.

Rainfall data.—The winter rainfall of North-Western India appears due to local evaporation, assisted by southerly winds, which bring vapor from warmer lands and seas in the south. The following general conclusion is herewith literally repeated—"Local evaporation from the land surface, from rivers, irrigation tracts, swamps and perhaps forest, furnishes an appreciable quota to the vapor afterwards locally precipitated as rain. This appears from many considerations. The most salient instance of the fact is that furnished by the occurrence of occasional rain in Kashgar, where the only possible source of vapor is that from irrigated tracts. But India itself also furnishes many illustrative cases, among which we would particularly mention the heavy spring rainfall of Assam, the increased precipitation along the course of the Indus, both in the lower Punjab and Sind, and also that of the drainage basin of the Godavery. We are much inclined to the belief that the extension of the irrigation and tree planting, more especially in such arid tracts as are portions of the Punjab, Rajputana, and Sind, are

* This we have now received, and can vouch for its excellence.—[ED.].

gradually bringing about an appreciable amelioration of the climate."

Special observations.—The temperature of the ground was observed for three years at Allahabad. The depths were 0·5 foot, 1 foot, 3 feet. The ground temperature is between 4 and 5 degrees in excess of the air temperature.

At Jeypore a difference of 4·2 degrees was observed. A similar excess having been found at Trevandrum, Calcutta, and Allahabad, it may be inferred with much probability to hold good over the whole of India.* More complete observations of ground temperature are in progress under Mr. Hennessey of the Survey Department at Dehra, but have not been noticed by Mr. Blanford, nor have the experiments of the influence of forests on rainfall and temperature in the School Circle, N.-W. Provinces. It would be a great improvement if the annual report of the Meteorological Department referred to all meteorological work in progress in India, even if it is independent of the Department.

INDIAN METEOROLOGICAL MEMOIRS.

Edited under the direction of H. F. Blanford, F.R.S., *Meteorological Reporter to the Government of India.*

III.—Notes on Mr. Chambers' list of Cyclones, and on the Gujrat Land-Cyclone of July 11th to 13th, 1881. *By* H. F. Blanford, F.R.S.

That the formation of cyclones is a consequence of heavy local rainfall is a general law, which not only has resulted from the discussion of every storm in the Bay of Bengal, which has been made the subject of special enquiry, but is the only view which appears to offer a satisfactory deductive account of the phenomena. But hitherto, the only storms which have offered themselves for investigation, are such as have originated at sea, and the only observations available have been those recorded on ships, with unverified instruments, and in positions which, in many cases, could be determined only approximately. Added to which all measurement of that most important element, the rainfall, around the birthplace of the storm, has been impracticable. It is, therefore, an occurrence of more than ordinary interest that presents itself in the Gujrat storm of the 11th and 12th July, 1881, which, having been generated on a land surface, in the midst of well equipped meteorological observatories, has fulfilled in a high degree all those conditions that are demanded by scientific enquiry.

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* Experiments carried on at the Great Trigonometrical Survey at Dehra Dún gave a mean ground temperature of 75·0° in the year 1882, whilst the mean air temperature during the last 20 years was 70 7° only.

Two days before the storm a very extensive area of low barometer existed. The barometric depression was slightly intensified the next day, by a further fall over the area and a rise around it. A strong monsoon current entered from the south, and fed the heavy rain which set in over a portion of the depression. The storm vortex which first appeared between Bhuj and Rajkot on the night after the second day coincided exactly in position with the seat of the heaviest rainfall, much of which had fallen during the previous day; and during the whole of the third day and the forenoon of the 4th day (13th July), it shifted but slightly to the westward of its place of origin, a deluge of rain falling without intermission immediately around.

IV. On the Temperature of North-Western India. *By* S. A. Hill, *B.Sc.*

Some topics of general interest have already been referred to in the Administration Report. The following are herewith supplemented.

The epoch of daily minimum air temperature varies with the hour of sunrise, generally preceding it by a quarter of an hour; and on the whole occurring earlier; as the elevation of the station is greater. The maximum air temperature occurs between 2 and 3 P.M. on the mean of the year. At the hill stations the maximum is reached sooner than in the plains.

From comparative observations at plain and hill stations, the decrement of temperature has been determined for different heights. Between 0 feet and 12,000 feet a total decrement of 33·15° has been calculated. The decrement is greater at the commencement and diminishes regularly. From 0 feet to 1,000 feet it is 3·12°, and from 11,000 feet to 12,000 feet it is 2·47°. It is probable that the decrement in the free atmosphere is greater. The above figures are understood for the air near the surface of the ground.

THE THARANDTER JAHR BUCH FOR JANUARY, 1884.

Considerable space in this number is taken up by an elaborate account of the distribution and life-history of the common mistletoe, by Professor Nobbe, which is not of much interest except to botanists. It is curious, however, that the plant is not known to occur in Germany on either of the oaks, and that an attempt to raise it artificially on *Q. Robur* failed, although it is well-known to occur on oaks in England. It seems to be most frequent on poplars, fruit trees, maples, ash, and silver fir, but,

as the writer says, it would be easier to enumerate the genera which are not known to furnish it with hosts than those which are already known to do so.

Professor Kunze has two papers of interest to practical foresters. The first is on the effect of different degrees of thinnings on the increment of beech-groups. The forest experimented on consisted of a vigorous group with complete cover, of an average age of 49 years, and was the result of natural regeneration by seed. The ground was covered at the commencement of the experiment in the autumn of 1861 with a thick layer of humus, without secondary growth of any kind, and was divided into three equal portions, each of ·8301 hectare (2·075 acres). Of these, one was thinned severely every five years, the second was moderately thinned, and the third was not thinned at all. The contents of the wood on each plot were determined by felling average-stems; and five major-classes were formed in each case, from which the representative stem for each group was deduced, and the contents of the whole determined accordingly. This operation was performed again at the end of each period of five years, and the increment during a period was found by deducting the contents of the group at the beginning from its contents at the end of the period. The results were as follows:—

1.—*Thinnings severe.*

Period.	Growth, per cent.	Period.	Growth, per cent.
1862–67, ...	4·55	1873–77, ...	3·72
1868–72, ...	3·88	1878–82, ...	3·16

2.—*Thinnings moderate.*

Period.	Growth, per cent.	Period.	Growth, per cent.
1862–67, ...	3·62	1873–77, ...	3·04
1868–72, ...	3·12	1878–82, ..	2·47

3.—*No thinnings.*

Period.	Growth, per cent.	Period.	Growth, per cent.
1862–67, ...	3·43	1873–77, ...	2·47
1868–72, ...	2 84	1878–82, ...	2·49

In the year 1882, the standing stock of the groups consisted of :—

In experimental group. No.	Log wood.	Spray.	Total.
	Cubic metres.		
1, ...	182·68	68·53	251·21
2, ...	181·65	69·23	250·88
3, ...	221·90	95·21	317·11

The growth per cent. was greater in (1) than in (2), and also greater in (2) than in (3). On the other hand, the quantity of log wood yielded at the end of each period was on the whole slightly greater in (3) than in (2), and in (2) than in (1), and the same remark applies to the total quantity of standing stock left after each thinning; the difference being always very marked between the unthinned group and either of the thinned groups.

It was also noted that after the second thinning moss began to appear in numerous patches in number (1), where other small ground-plants (*Pulmonaria officinalis*, *Oxalis acetosella*) were also most numerous, but almost quite absent in the unthinned group. Again, in the spring of 1883, there arose a tolerably dense growth of young beech seedlings in No. 1; the same result was noticeable but in a much less degree in No. (2); there was no young growth at all in No. (3).

It would appear then, that the thinnings were too severe in both (1) and (2), and that if persisted in, the soil would become impoverished, and over-run by weeds, which would probably result in the deterioration of the group.

The second paper, by the same writer, is on the degree of accuracy attainable by employing experiential form co-efficients in estimating the contents of standing stock. The usual custom in estimating standing stock when the greatest accuracy possible is desired, has hitherto been to adopt the method of separate classes with separate average trees for each class. It has, however, been shown that even by this method results may differ very appreciably from those obtained by cutting down all trees and measuring the contents of each separately. Kunze, for instance, experimented on three plots of spruce and on three of Scot's pine, taking in each case five major-classes (felling at least three average trees in each), and obtained the following percentages of error, which were estimated by comparing results

with those afterwards obtained by felling all trees and estimating the contents of each one as it lay :—

	Spruce.			Scot's Pine.			Mean error for whole.
	Experiments			Experiments			
	1.	2.	3.	4.	5	6.	
Trunk only,...	+ ·36	+ 2 80	+ 1·93	+ 2·87	+ 1·58	+ 4 37	2 32
Whole tree,...	+ ·45	+ 3·06	+ 2·50	− 2 44	+ 1 53	+ 6 53	2·75

Kunze also measured the same groups standing, employing only one average-tree, which was obtained by taking the average of five sample trees. The results were, for the trunk alone, a mean error per cent. of 4·00 ; and for the whole tree of 4·89.

The same groups were also utilized to find out the error made in estimating their contents by form co-efficients. The latter were obtained from experiential tables compiled by the Organization Department in Saxony. The formula for finding contents of a group by this method is—

$$M = A\,h\,f.$$

Where M = contents of group.
A = sum of basal areas of all trees at breast height.
h = mean height of group.
f = average form co-efficient.

A was obtained by actual measurement ; h was obtained by measuring, with the hypsometer, a number of *apparently* average trees and taking the mean ; and f was taken from the tables.

The mean error was :—

	Spruce.			Scot's Pine.			Mean error per cent.
	Experiments			Experiments			
	1	2	3.	4	5	6.	
Trunk only, ...	+ 5 99	+ 2 53	− 1 11	− ·74	− 2 74	+ 1 59	2 51
Whole tree, ...	+ 1·77	+ 1·23	− 5·24	− 1·84	− 4 94	− 0·54	2·59

These results are as good as those obtained by the much more elaborate method which requires the formation of height and diameter classes and the felling of sample trees ; it appears, therefore, probable that, with carefully prepared tables, the hitherto despised method of co-efficients—the simplest we have

—may, after all, prove to be as accurate as almost any other for the determination of the contents of standing stock.

The remaining papers in this number are not of general interest. There is a long one by Professor Richter on the import and export of wood over the German borders, and a short one on a purely personal matter by Judeich.

L. M. G.

PRESERVATION OF SAMPLES.

THE following process is employed in the Government of India's office to preserve samples of grains, &c., required to be kept for show in museums.

Three gallons (1 dozen quart bottles) of methylated spirits of wine is put into an earthen jar, to which is added two pounds of corrosive sublimate. The solution thus formed is a deadly poison.

The sample is sorted and cleaned, placed in a China basin, and a quantity of the solution, sufficient to cover it, is poured over it with a spoon, and well stirred. The grain is then left in the solution for ten minutes, and then spread out in the air or dried in the sun.

When dry the sample should be kept in an air-tight tin case with glass front.

Care should be taken that the person applying the poison does not touch it with his hand, for the effect is a painful and dangerous swelling. The man may wear leather gloves. The poison is comparatively harmless to animals when dry. Rats will eat the poisoned samples, although the process is a sufficient protection from insects and weevils. The poisoned samples should not, however, be tasted.

T. N. MUKHARJI,
Rev. and Agri. Dept.

NOTE.—Pure carbolic acid may be added. The vernacular name for corrosive sublimate in Lahore is *Dár Chikna*, if this be too strong in the solution, it will show as a white powder. Mr. Baden Powell's rule is to put in corrosive sublimate and dilute, till when brushed on an absorbent surface, scarcely any white powder shows.—J. L. KIPLING.

III. Notes, Queries and Extracts.

The International Forestry Exhibition.—Through the courtesy of Earl Granville the Executive Committee of the Forestry Exhibition have now been made aware of the disposition and intentions of many of the foreign Governments of Europe with regard to this enterprise. These are in all cases most friendly. Some countries, such as Egypt, Tangiers, Greece, &c., from the small number of their forest products, and the imperfect knowledge of their amount and uses, or from the short time at their disposal in the absence of a regular forest department, are unable to contribute. Other countries, like Belgium, Portugal, Switzerland, the Netherlands, and Hayti have caused notices of the exhibition to be inserted in their respective official gazettes, and have directed the attention of their people towards it. The Government of the United States, whose former superabundance of wood has been rapidly decreasing under the vast demands of trade, will take every available means to give the subject due publicity and to contribute thereto. The attention of the Governor-General of the Netherlands, India, has been also officially invited. The Maharajah of Johore, whose territory lies adjacent to our Straits Settlements, has joined in the list of patrons, and proposes to send exhibits. The Rajah (Sir C. Brooke) of Sarawak, while unable himself to contribute, has directed his representatives in Borneo, Siam, and Java, to give all assistance to the directors of the Borneo Company in forming a representative collection. Several officials of the Shah of Persia have heartily taken up the idea, and have announced their intention of exhibiting. Meanwhile, applications for space as well in the building as outside come in from private individuals in large numbers, and the careful scrutiny of the merits of such applications is increasingly apparent and necessary. An offer of a prize of £50 for an essay on the best method of maintaining the supply of teak as regards size and quality, together with the best substitute for shipbuilding purposes, was made by the shipbuilders of Glasgow, and was accepted.—*Timber Trades Journal.*

How Creosoted Timber burns.—One objection which has been urged against creosoting as a means for preserving timber, in addition to its expensiveness and the difficulty in the way of thorough injection, has been the alleged inflammability of wood

treated by the creosoting process. As the creosote is in the form of dead oil or tar, the burning quality of wood impregnated with it would, inferentially, be excellent. Yet it is claimed that, in a recent case, this theory was substantially demolished by results. An establishment for creosoting piles and planks was burned in New York a few days ago, to which the presence of creosote afforded considerable protection against the fire. The fire is thus described: The building was of pine and spruce in their natural state, except the sills, which were made of creosoted pine. The latter were set on posts and raised about a foot above the ground, so that the flames had a chance to get under them; they were charred, yet retain their form and a certain amount of strength, whereas not a piece of the untreated lumber could be found. Scattered over the premises were numerous creosoted piles, and several thousand feet of plank, all charred, but the pieces mostly retained their original form and a certain degree of usefulness. Where the flames could reach the comparatively uninjected heart wood, they ate into it, leaving a charred creosoted shell. In all the above charred pieces the fire went out of itself: creosoted wood burns with a dense black smoke, which probably has a smothering effect.—*Lumberman.*

TIMBERS AT THE CALCUTTA EXHIBITION.—Having inspected the basket-ware and the trade samples of jute and gunnies, the visitor's attention will in all probability be engaged with the beautiful gateway which forms the northern entrance into the Economic Court. This was constructed by Mr. F. B. Manson, the Forest Officer in charge of the Forest Department exhibits. This magnificent conception is in structure similar to the Indian-corn arch, but instead of corn cobs, it is built up entirely of blocks of differently coloured woods, neatly arranged and polished. I was told that there are over 2,000 different pieces of wood used in the construction of this, the trophy of the Forest Department, and the taste and care bestowed upon it do great credit to the Department and to Mr. Manson, who had entrusted to him the work not only of constructing this trophy, but of receiving all the timber collections, and of classifying and arranging these. I am sure every one will agree with me in thinking Mr. Manson did well to follow out the same plan as was pursued by Dr. Watt in his general arrangement of the Economic Court, namely, to select an index collection, and to use the duplicates for ornamental purposes. On the wall will be found on racks a complete set of blocks of all the Indian timbers, alphabetically arranged, so as to facilitate rapid reference. Mr. Manson has prepared a valuable catalogue of these, which, with the sanction of the author, is an abstract form of Mr. J. S. Gamble's *Manual of Indian Timbers*, arranged alpha-

botically. I have little more to add to the subject of timbers; most are well-known, and I venture to think a much larger and more perfect collection was sent from India to the Paris Exhibition than is now on view at the great Calcutta International Exhibition. This is certainly to be regarded as a very great mistake, and I think it remarkable that there should be two or three much larger and more perfect collections of Indian Timbers in Europe than we possess in India. In fact I believe no fresh collections have been made for the Calcutta Exhibition, and, with the exception of a few blocks from Bombay and Madras, all have been exhibited before. I noticed, however, one new collection of a practical nature, namely, a series of seasoned and corresponding green woods of the leading tea-box timbers tied up with sheets of lead between each. These have been subjected to the most severe ordeal possible, in order to ascertain the action of the wood upon the lead. I had the pleasure of seeing a few of these opened, and although in one or two instances the wood had become almost rotten, the lead had not been in the least corroded. The reports which have agitated the public mind on this subject would therefore seem to be incorrect. The wood has no action upon the lead whatever, and if it is the case that the lead had been found corroded on arrival of the tea chests in Europe, this would seem to be due either to impurities in the lead itself, or to some chemical action of the tea, or of certain preparations of tea only, upon the lead and not to any action of the wood upon the lead, whether used seasoned or green.* Before leaving the Economic Court I must pronounce it a most perfect success, replete with interest to India and India's future.—*Pioneer.*

CURRENT PRICES OF ENGLISH TIMBER.—There is very little alteration in the prices of the various kinds of timber since our last report in September: selected oak and ash command a firmer price, beech is rather scarcer and dearer, in poplar very little has been doing, and frequently holders accept very low prices to clear, for some local reason or some particular circumstance; sycamore of large size and good quality is very scarce, and much inquired after, the price obtainable continues to improve.

The price list represents the average prices obtainable by proprietors for timber lying within a three or four mile haulage to a station, with reasonable rates to the chief consuming centres.

Good selected oak,...	...	...	1*s.* 9*d.* to 2*s.* p. c. ft.
Second quality ,, ...	...	...	1*s.* to 1*s.* 6*d.* ,,

* Mr. Young, Forest officer in Cachar, has proved that green *Mangifera sylvatica* wood, corrodes lead after being in contact with it for a fortnight only. —[ED.]

Good selected ash, ...	1*s.* 6*d.* to 2*s.*	p. c. ft.
Second quality „	1*s.* to 1*s.* 6*d.*	„
Elm fair average, ...	9*d.* to 1*s.*	„
Poplar average, ...	5*d.* to 8*d.*	„
Willow „	6*d.* to 10*d.*	„
Larch large fair average, ...	1*s.* to 1*s.* 3*d.*	„
„ small „	9*d.* to 1*s.*	„
Beech, „	9*d.* to 11*d.*	„
Sycamore large, ...	1*s.* 6*d.* to 2*s.* 6*d.*	„
„ small, ...	9*d.* to 1*s.*	„
Horse chestnut, ...	6*d.* to 9*d.*	„

—*Timber Trades Journal.*

RUBBER.—An esteemed correspondent writes to us:—"The Nagas in this portion of the Naga Hills (above Amgourie tea garden) are getting a good deal of rubber from a woody vine. The vine climbs trees and grows to three or four inches in diameter. When the seed-pods are ripe, they burst open, and a light flimsy material comes forth, and is wafted about by the winds. It is this fact that gives to the vine its Naga name *Apungmange*. The botanical name I do not know. The vine is common in the forest jungle of these hills, and the Nagas say it is in the forests at the base of the hills, but not as abundant as in the hill forests. The juice in the green state and when dried has every appearance of that from the rubber tree. It might be well for Government to ascertain how abundant this forest vine is in the plains and other hill districts of India: also to give a thorough test of the value of the rubber from this vine.—*Indian Agriculturist.*

THE PRICE OF TEAKWOOD, particularly Burmah teak, has risen very much within the past year or two. Logs that could be purchased at Rs. 60 or Rs. 70 per ton, now cost Rs. 140, and it will soon be a question of finding some other timber as a substitute for it. Australia bids fair to supply this, and India will soon be compelled to draw on this colony for her timber supply. An enterprising firm in Madras has imported a consignment, and a Madras paper hears that Government intend to give the timber a trial. A wood that will not decay rapidly on immersion in water, is wanted, and an experiment is, we learn, to be made in the construction of a lock on the Buckingham Canal with this timber. If it should answer, it would soon become a very important item in the imports of the Madras Presidency, as it now is procurable at about a third of the cost of teak, and competition in the trade will no doubt reduce it still further.—*Madras Athenæum.*

IV. Extracts from Official Gazettes.

1.—Gazette of India—

No. 54.—*The 1st February, 1884.*—The undermentioned officer is granted furlough out of India with the necessary subsidiary leave:—

Major F. Bailey, R.E., Conservator of Forests, 2nd grade, Superintendent of Forest Surveys and Director of the Forest School, North-Western Provinces, (p. a.) for one year and 182 days, under rule IX. of the regulations of 1868.

No. 90.—*The 8th February 1884.*—Consequent on the grant of furlough to *Major F. Bailey, R.E.*, Conservator of Forests of the 2nd grade, in charge of the School Circle in the North-Western Provinces and Oudh, Director of the Forest School at Dehra Dún, and Superintendent of Forest Surveys, the following temporary promotions are made, with effect from the date on which *Major Bailey* may avail himself of the leave in question:—

Mr. G. Mann, Conservator of Forests of the 3rd grade in Assam, to officiate in the 2nd grade of Conservators of Forests, until the issue of further orders.

Mr. W. R. Fisher, B.A., Deputy Director of the Forest School, to officiate as Conservator of Forests of the 3rd grade, in charge of the School Circle in the North-Western Provinces and Oudh, and as Director of the Forest School, during *Major Bailey's* absence on furlough, or until the issue of further orders.

Mr. W. H. Reynolds, Deputy Superintendent of Forest Surveys, to officiate as Superintendent of Forest Surveys, in addition to his other duties, during *Major Bailey's* absence on furlough, or until the issue of further orders.

Mr. E. E. Fernandez, Superintendent of Working-Plans, to officiate as Deputy Director of the Forest School, until the issue of further orders.

No. 144.—*The 29th February, 1884.*—The following temporary promotions are made among Conservators of Forests during the absence on three months' privilege leave of *Mr. B. Ribbentrop*, Conservator of Forests of the 2nd grade in the Punjab, with effect from the 5th February, 1884:—

Mr. A. L. Home, Conservator of Forests of the 3rd grade in Bengal, to officiate in the 2nd grade of Conservators of Forests.

Mr. A. E. Wild, Deputy Conservator of Forests of the 3rd grade in the Punjab, to officiate in the 3rd grade of Conservators of Forests, and to have charge of the Forest Department in the Punjab.

2.—CALCUTTA GAZETTE—

Nil.

3.—NORTH-WESTERN PROVINCES GAZETTE—

No. 390.—*The 6th February, 1884.*—The Hon'ble the Lieutenant-Governor and Chief Commissioner is pleased to declare the undermentioned officers to have passed the Departmental Examination in the subjects specified below.

By the Higher Standard in Vernacular.

1. *Mr. F. B. Bryant*, Assistant Conservator of Forests.
2. *Mr. R. J. P. Pinder*, Officiating Assistant Conservator of Forests.

By the Lower Standard in Vernacular.

1. *Mr. N. Hearle*, Officiating Deputy Conservator of Forests.
2. *Mr. A. G. Hobart-Hampden*, Assistant Conservator of Forests.
3. *Mr. M. H. Clifford*, Assistant Conservator of Forests.

No. 112.—*The 19th February, 1884.*—With effect from the 16th November, 1883, *Mr. E. McA. Moir*, Deputy Conservator of Forests, to hold charge of the Tons Forest Division of the School Circle, in addition to his other duties, as a temporary arrangement.

No. 241.—*The 22nd February, 1884.*—Under section 14 of Act X. of 1882, *Mr. S. Eardley Wilmot*, Deputy Conservator of Forests, 4th grade, to be a Special Magistrate and to be invested with the powers of a Magistrate of the 2nd class, to be exercised within the limits of the Government forests in the Kumaun Division in respect of offences punishable under Act VII. of 1878.

No. 143.—*The 26th February, 1884.*—*Mr W. R. J. Brereton*, Deputy Conservator of Forests, on return from furlough, to the charge of the Ránikhet Forest Division of the Central Circle.

No. 144.—*Mr. F. B Bryant*, Assistant Conservator, on being relieved by *Mr. W. R. J. Brereton*, to be placed on special duty in connection with the demarcation of forests in Garhwál.

4.—PUNJAB GAZETTE—

No. 58.—*The 8th February, 1884.*—It is hereby notified that *Messrs. J. H. Lace*, and *E. S. Carr*, Assistant Conservators of Forests, have passed the Departmental Examination by the Higher Standard in Hindustani.

No. 76.—*The 15th February, 1884.*—The promotions of *Messrs. J. C. McDonell, G. G. Minnikien* and *W. E. D'Arcy*, ordered by Notification No. 481, dated 16th November, 1883, should have effect from the 1st October, 1883, and not from the 2nd idem as therein notified.

No. 82.—*The 16th February, 1884.*—*Mr. C. F. Elliott*, Deputy Conservator of Forests, Ráwalpindi Forest Division, is granted furlough to Europe for one year and seven months, under Section 49 of the Civil Leave Code, with effect from the 25th March, 1884, or such subsequent date as he may avail himself of it.

No. 87.—*Mr. J. H. Lace*, Assistant Conservator of Forests, 2nd grade, is promoted to Assistant Conservator, 1st grade, *sub. pro tem.*, with effect from the 10th November, 1883.

5.—CENTRAL PROVINCES GAZETTE—

Nil.

6.—BRITISH BURMA GAZETTE—

Nil.

7.—ASSAM GAZETTE—

Nil.

8.—MYSORE GAZETTE—

Nil.

9.—MADRAS GAZETTE—

The 3rd February, 1884.—*Mr. E. Dampier*, Sub-Assistant Conservator of Forests, Ganjam, is granted three months' sick leave on half pay, with effect from 2nd February, 1884.

The 6th February, 1884.—

Rules for the Examination of Forest Subordinates in the Southern Circle.

The undersigned publishes, for general information as regards his Circle, the following extracts from rules which have received the approval of Government in their Order No. 1506, dated the 1st December, 1883.

1.—*Subject of Examination*—The Examinations to be passed by officers of the subordinate staff are—

1. Language Test.
2. Surveying Test.
3. Departmental Test.

The language test may either be in English or the Vernacular. This test is, however, not required from officers who have passed the Middle School Examination, first-class certificate, from Graduates, or holders of the F.A. certificates of the Madras or other Indian University, or from Matriculates of that University who have also passed the handwriting test.

2.—*Language Test.*—The following is the test for language examination :—

I. Reading fairly, and translating with accuracy, an original native letter or report of moderate length and difficulty in the language of the district.

II. Dictating an order.

III. Rendering into English a vernacular report read out.

IV. Conversing with the Examiner, or with natives of India, on subjects likely to occur in the performance of professional duty, in the transaction of ordinary business, or in the course of every-day life. If the candidate prove his ability to comprehend readily all that is said to him and to make himself fairly intelligible, more should not be required of him.

Hindus and Muhammadans not being Matriculates or not having passed First-class Middle School Examination must pass the

same test in English The examination will be conducted under the control of the Collector of the district.

3.—*Survey Test.*—The surveying test will be as follows:—

"A circuit round an area of not less than two square miles of flat country to be traversed with a prismatic compass and chain; the bearings, distances, and offsets to be recorded in a field-book and to be plotted on a scale of not less than eight inches = one mile. The roads, paths, streams, houses, and other topographical features to be filled in by plane-table and chain. If the officer conducting the examination certifies that no plane-table is available, the interior detail should be filled in by prismatic compass and chain. A line not less than one mile in length to be levelled throughout from both ends, and the sections to be afterwards plotted on a scale of eight inches =one mile for horizontal distances, and not less than twenty feet = one inch for vertical distances."

The examination may be held at any time that is convenient to the examining officer, *i.e.*, the nearest Deputy Superintendent of Survey or Executive Engineer, who will forward the maps and field-book to the Conservator of Forests, with his recommendations, and a certificate that the work is *bonâ fide* that of the officer under examination, and that it has been done under his supervision.

The Conservator, having satisfied himself that the rules have been strictly adhered to, will countersign the certificate and intimate the result to the candidate.

4.—*Departmental Test.*—The Departmental test will be in the following subjects:—

(*a*). The keeping of forest accounts and returns.

(*b*). The Forest Act and Rules of the District.

(*c*). Acquaintance with the timber trees and important forest products of the district and their qualities and uses.

(*d*). The timber trade and consumption of timber, fuel, and other important produce in the district and surrounding country, with the system of extraction and rates of labor, including the management of elephants.

(*e*). The general management of forests and plantations and the duties of the forest staff in protection; the system used to protect forest from fire, the demarcation of reserved forests, and the construction of forest roads and forest houses.

The examination will be conducted by means of written papers to be drawn up by the Conservator of Forests. who will either hold the examination himself or send the papers to the Collector to be set to the candidate.

The answers of the candidate will then be returned to the Conservator, who will decide on the result, and, if the candidate has passed, notify the same in the *Fort St. George Gazette.*

The papers set should not be of too difficult a character, but

should be generally suitable to the intelligence of subordinate officers, refer chiefly to the works and conditions peculiar to the district, and embrace as wide a field of forest knowledge as possible.

The examinations will ordinarily be held in the first week in each half-year, that is, in the first weeks of January and July, and District Forest Officers should arrange to give at least a month's notice to the Conservator of the intention of any officer to appear. The first Departmental Test examination under these rules will be in April next.

No applications to appear for examinations should be submitted for the Conservator's sanction unless the District Forest Officer has satisfied himself that the candidate has a reasonable expectation of passing.

5. *First Appointment as Forester.*—On first appointment to the class of "Forester," the following certificates are necessary:—

   1. That the candidate is not over 25 years of age.
   2. That he is either—
      i. A Graduate of the Madras or other Indian University, or
      ii. Holds the F.A. certificate of such University.
      iii. Has passed the Matriculation Examination and Handwriting test.
      iv. Holds the first-class certificate of the Middle School Examination.
   3. That he produce the prescribed medical certificate of physical fitness.

The Conservator may appoint candidates who have not submitted certificate No. 2 on condition that they submit it within a period of probation to be fixed by him.

6. *First Appointment to Forest Ranger.*—First appointment to the class of Forest Ranger will, as far as possible, be made by the promotion of Foresters on the condition that—

   i. They produce the certificates required by paragraph 5.
   ii. They are considered on probation until they have passed the test in surveying and the departmental tests required by paragraphs 3 and 4. The time of such probation will be fixed, in each case, by the Conservator. Similar conditions will regulate direct appointments to the Ranger's class.

7. *Promotion to Sub-Assistant Conservators.*—Before promotion to the class of Sub-Assistant Conservator, a Forest Ranger must have passed the examinations, described in Rule 1 and be reported to be otherwise properly qualified, active and intelligent, and capable of carrying out the duties of a District Forest Officer. Preference will be given to those who obtain the Ranger's certificate at the Forest School.

8. *Tests required of Candidates for office appointments.*—The

following is a table of the several tests required of candidates for admission to the office establishments of the department:—

Office.	Middle School Examination in the First Class.	Account Test, Special Test VI.	Translation Test, Lower Grade, Special Test VII B.	Précis Writing, Higher Grade, Special Test VIII A
Conservator of Forests,	All employés in appointments of the value of Rupees 20 and upwards in permanent establishments,	Accountants on Rupees 40 and upwards, the test in book-keeping only.	Head Clerk.	Head Clerk, Referencer.
District Forest Officer,	Do. do.	Head Clerk and Accountants on Rupees 30 and upwards, the test in book-keeping only.	Do.	

Graduates are exempt from passing the Précis-writing and Translation tests.

These rules came into force from the 1st December, 1883, and apply to all Rangers, Foresters, and Clerks who are now on probation.

10.—BOMBAY GAZETTE—

The 6th February, 1884.—Mr. J. M. Fernandez, who was in Government Resolution No. 8693, dated the 27th November, 1883, transferred to Belgaum to do duty as Acting Sub-Assistant Conservator of Forests, received charge of the Sub-Assistant Conservator's office there from the Forester of Belgaum on the 1st ultimo, before office hours.